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CAN CERTAIN DISEASES OF THE EAR, NOSE AND THROAT, ESPECIALLY DEGENERATION OF THE VIIIITH NERVE, BE CLASSIFIED AS "DEFICIENCY DISEASES?"*

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In THE LARYNGOSCOPE of April, 1922, I published an article on "Disturbances of Metabolism in Relation to Diseases of the Ear, Nose and Throat," and covering studies during the years 1915-1922. I stated in this article that the chemical "actions, reactions and interactions" within the human body seemed to be under the control of certain chemical messengers, activators and retarders (hormones), and that these messengers have their origin in the endocrine gland system. The evidence still points to their being the controllers of the blood electrolytes, calcium, phosphorus, potassium, magnesium and sodium and the evidence is slowly pointing to the pituitary as the great regulator. Data suggests that apparently the thyroid and parathyroid control calcium, the adrenal cortex potassium and sodium, and there is, according to Collip, the theory that the parathyroid may have an influence on magnesium. Prof. C. L. A. Schmidt says this has since been proven.

There is evidence also that the vitamins are influenced by some of the endocrines, notably the cortex in relation to B and C and possibly A. As to the pituitary, Harvey Cushing in the Harvey lectures of 1932, thought the growth hormone and the

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growth vitamin were unrelated, and that either could be the limiting factor of growth. Collip, in a recent letter to me, says "We have done a little work, attempting to correlate vitamin deficiency with hypophyseal insufficiency, but as yet our efforts in this direction have been unsuccessful."

It is also known since 1922 that vitamin D is necessary to the proper utilization of calcium, and it appears that the cortex through vitamins B and C may influence both potassium and sodium. Nothing, however, has appeared that I know of to prove this statement in so far as potassium is concerned.

During the past three years my thoughts and energies have been directed somewhat intensively to the absorbing subjects of nutrition and biochemistry, their deficiencies and their relation to human life, and especially their relation to chronic sinusitis, chronic progressive deafness and allergy.

Indeed, I believe deficiencies in the endocrine system, abnormalities in the electrolyte balance and the lack of other "mineral elements occurring as traces" (Rose), deficiencies in the vitamins and possibly amino acids, meteorological conditions and certain environmental factors (tobacco, alcohol, sex) are the fundamental causes of these conditions.

I shall endeavor, therefore, to build from a very short historical sketch of deficiency diseases, the foundation for my belief that many of the conditions seen in rhino-oto-laryngological practice, especially as regards VIIIth nerve deafness, present a fairly clearly defined picture of a fundamental deficiency disease.

Inasmuch as my own work has centered around the study of the vitamin B complex, and because much of the research work of today points to the B complex as most important, and because it is the particular vitamin missing in the world's deficient dietary, all my efforts have been directed to the B complex study.

McCollum and Simmonds point out: "For centuries in several parts of the world restricted diets of a monotonous character have produced disease in man." We also learn from them that pellagra, a scourge for centuries in Italy and France, thought to be due to the poor quality of a simple and monotonous diet, is really due, in part, to a deficiency of B₃, as discovered by Goldberger in this country 20 years ago.

Over 300 years ago the relation of scurvy to a lack of certain fresh vegetables and to citrus fruits was known, but it was a long time before the missing substance in these foods was designated as vitamin C. In more recent times, the work of Dr. James F. Rinehart and his co-workers in the Medical Department, University of California, suggest that a lack or shortage of vitamin C may play a role in the causation of rheumatic fever.

In the August, 1935, issue of the *Journal of Nutrition*, two articles appear on the subject of "Vitamin C and Resistance to Toxins," by King and Menten. They state in their conclusions of the second article: "Guinea pigs maintained on diets deficient in vitamin C, and injected with sublethal amounts of diphtheria toxin showed diffuse hyperplastic arteriosclerosis in lungs, liver, spleen and kidneys. No vascular thickening was observed in the heart. Such animals also developed hydropic degeneration of the islets of Langerhans and an associated hyperglycemia and lowered glucose tolerance. With recovery of the animal the pancreatic lesions disappeared.

It is quite possible, if C is the intracellular cementum, as is suggested by Menkin, Wolbach and Menkin, that it may prove of value in perennial vasomotor rhinitis (*i.e.*, those cases showing increased eosinophilia in smears of the nasal secretions, and where skin testing for epidermals, pollens and foods, fail to furnish a clue).

Fifty years ago in the Japanese Navy, beriberi was found to be due to a faulty diet, and about 1906, Eijkman, a Dutch physician, proved definitely that it was due to the too great use of polished rice, later designated as B₁. Many years elapsed, however, before Eijkman's data were accepted by scientists.

One has only to refer to the brilliant lectures of J. C. Drummond, Professor of Biochemistry, University College, University of London, delivered last year in San Francisco under the auspices of the "Lane Medical Lectures," and to read his sketch of "The Character of Modern Problems of Nutrition," to realize the importance of the nutritional disasters that have for over a century beset the British people, and to be informed that 50 per cent of the men offering themselves to His Majesty's army during the World War were rejected by the Medical Corps, for medical and physical grounds, due

largely to the advent of milling changes in flour production (the making of white flour), lack of butter, milk, fresh fruits and vegetables.

Likewise, in the Harben Lectures delivered in London in 1933 on the "Modern Views of Vitamins and Their Functions," in referring to the "disastrous industrial movement which has given us the highly milled cereal foods," he says, "Col. McCarrison, over 10 years ago rendered medical science a great service by pointing out in emphatic terms the grave dangers of long continued subsistence on diets containing an insufficiency of vitamin B." He (McCarrison) "stresses at every turn the importance of recognizing the widespread occurrence of mild deficiency," and is unquestionably right in insisting that vitamin deficiency is directly or indirectly responsible for a very large proportion of human ills today.

Drummond also noted severe dilatation of the stomach in many of his animals, and says that 50 per cent showed gastric or duodenal ulcers, these animals having been fed over a long period of time on a diet containing B, but in an amount insufficient for the normal requirements." He also refers (page 91, Stanford Lectures) to work that has been in progress for over two years in his laboratories. These studies followed a suggestion of McCarrison's that there was a "high incidence of disorders of the alimentary tract and of cardiorenal changes, in animals deprived of B." His work at the time of his lectures here was not finished but had gone far enough to confirm McCarrison's findings.

Drummond further tells (page 27, State Medicine) of a confrere who studied the dietary of English workmen and showed that their diet was "seriously deficient in the components of the B complex, in spite of being reasonably varied." This same condition was observed in "other typical English households, as also in several boarding schools."

Harvey Cushing, in a most illuminating article on "Peptic Ulcer and the Interbrain," in his summary and conclusions, suggests that "in the interbrain is a newly-recognized, long-overlooked station for vegetative impulses easily affected by psychic influences." These vagotonic individuals, linear in build, are readily upset emotionally, many are distinctly allergic; in fact, the large part of our allergics belong to the linear type. The majority are hypotonic, but many are hyper-

tonic. I called attention to the slenderly built individual as presenting a common type 20 years ago, and this has been elaborated by Wm. Palmer Lucas.

Cushing closes his article thus: "This, briefly, is as near as one can come with the data at hand, to an interpretation of the neurogenic origin of peptic ulcer and an explanation of its existing prevalence." Might not one add, that the individual whose diet for many years has been partly deficient in B as well as D, and low in calcium, is a ready victim for ulcer, when the stress and strain, mental particularly, so often seen in the present depression, overwhelms him?

In connection with McCarrison's and Drummond's studies in relation to partial B deficiency diets and cardiorenal conditions, Leary (page 387, *Annual Review of Biochemistry*, 1935) says: "atherosclerosis is responsible for 95 per cent of non-syphilitic lesions of the visceral arteries, especially of the coronary, cerebral and renal vessels." He believes that "atherosclerosis is a nutritional disease amenable to prophylaxis, nutritional treatment, and that it is not an inevitable consequence of age since it appears in the young." This condition apparently is associated with high cholesterol (fats) intake.

Brody, commenting on Ismail's work, says that Ismail's "well-to-do patients in Egypt subsisting on European diets showed a high incidence of atherosclerosis, while his hospital patients, subsisting largely on carbohydrates, showed a low incidence of atherosclerosis." Brody, commenting on the various discussions of animal experiments in relation to arteriosclerosis, says "the discussion indicates chronic over-feeding of lipoids and carbohydrates, therefore, tends to shorten the life span."

Keefer, of the Thorndyke Memorial Laboratory, Harvard College, writing in 1931 on "Some Clinical Aspects of Deficiency Diseases," mentions the following conditions: "abducens palsy, facial palsy, leukoplakia, zerostomia, dental caries, papillary atrophy, hemeralopia, xerosis conjunctivae, xerosis cornea, keratomalacia, retrobulbar neuritis, lenticular opacities, recurrent laryngeal paralysis, anemia, cardiac insufficiency, acrodynia, rickets, osteomalacia, osteoporosis, scurvy, edema, pellegra, purpura, polyneuritis, combined system disease, tetany," as possible vitamin deficiencies.

Carmalt-Jones, describing edema in beriberi, in cases being treated with Marmite (B made from yeast), says his cases all had advanced myocarditis, and while their edema was improved, all promptly died before the edema was entirely relieved. In his cases of pernicious anemia, the edema was satisfactorily controlled by large doses of Tiki-tiki (rice polishing B complex).

Minot, also of the Thorndike Memorial Laboratory, writing in 1929 on "Some Fundamental Clinical Aspects of Deficiencies," says: "it is known today that abnormal amounts, or an improper balance, of highly potent active principles derived from glands of internal secretion, and of vitamins, of inorganic or other substance contained in food, can lead to many sorts of disorders," and that "deficiency disease in man may have a complex etiology, and dietary defects are not often alone the lack of vitamins, but complicated, for example, by incomplete or low protein intake, excess of carbohydrate, infection or by altered physiological mechanisms." Likewise he says: "The effects of a persistent slightly faulty diet may become detectable only after many years, and perhaps not for generations," and for that reason (in a short personal talk) Professor Drummond stated the earlier in life the evidence of deficiency is recognized (as in sinusitis, for instance), the sooner the correction in diet is made, the better the outlook.

There is increasing evidence from the literature published during the past two years that the principal role of vitamin B is its relation to the nutrition of the nervous and muscular systems, and perhaps the cardiovascular system, as an intermediary factor in the conversion of glycogen and other sugars to lactic acid. In other words, there is contained in the B complex a respiratory enzyme, probably Flavin, the lack of which in sufficient quantity, produces alterations in the oxidative processes of tissue and produces an accumulation of lactic acid. This one sees in the heart muscle, for instance, explaining some cases of brachycardia, according to Birch and Harris, and for the same reason may explain some of the beginnings of myocarditis. Harris says further: "It is of importance, however, to appreciate that a variety of inadequate diets are capable of producing such profound disturbances in the cardiovascular system that severe circulatory failure may appear."

Seemingly the connection between the symptom opisthotonos seen in the polyneuritis of pigeons and rats is definitely

due to local accumulation of lactic acid in the base of the brain. This has pretty definitely been proved by the work of Peters and Thompson. Drummond mentions it, and Frickett, of Alabama, calls special attention to changes in the neighborhood of Deiter's nucleus as explaining the retracted head and shuffling awkward position and gait of pigeons. His researches indicate, therefore, that the changes are central and not peripheral.

From Cogill's evidence of atony of the gastrointestinal musculature in B avitaminosis, might not a similar condition exist in the bronchial mucous membrane? From recent evidence that the intestinal mucosa (small gut) contains large amounts of vitamin C, and since it is probable that C acts as an intracellular cementum, or produces a substance having that property, and in view of Cogill's evidence as mentioned above, we may have in these two substances an explanation of intestinal permeability in cases of multiple food allergies.

It has been stated that liver extract given for polycythemia in asthmatic subjects has afforded relief to those asthmatics, and is some evidence that through B₂ it influences smooth muscle in the bronchi, as it apparently does in atony of the intestines.

Bodansky says avitaminosis B is characterized by depressed tissue oxidation and accumulation of lactic acid in the tissues (brain and muscle), thus explaining some fatigues (physical as well as mental). It is also suggested that the metabolic rate is proportional to its deficiency, that hypertrophy of the heart is associated with water retention and returns to normal on the administration of B.

McCarrison and Sankaran tell of an interesting experiment in chickens "on the growth of tissue in vitro," that throws some light on the possibility of restoring some of the damaged cells in the acusticus nerve, provided of course, the degeneration in the receptive area of speech (*i.e.*, from 240 d. v. to 4096 v. d.) has not proceeded to complete atrophy.

The diet used in his experiments was a B₁ and consisted of washed polished rice, cod liver oil and orange juice. The plasma from this hen was greenish yellow, in contrast to the fairly yellow tinge of the plasma from healthy fowls.

Into the deficient and normal plasma, to which was added tyrode solution, equal parts, he puts nerve cells from the spinal cord of an eight to nine day old chick embryo. In the study of these nerve cells he noticed the growth was vigorous in the normal plasma, while in the deficient plasma the cells "underwent rapid degeneration." Col. McCarrison's conclusions were that the "deficient plasma was not only lacking in the growth promoting factor, B₁, but it caused degeneration of nerve cells." This experiment is a possible explanation of the degeneration beginning usually in the fourth decade of life, which continues, unless measures are taken to overcome the deficiencies, to almost complete atrophy of the cochlear branch of the nerve.

ARTICLES RELATING TO OTO-LARYNGOLOGY.

The three outstanding articles relating to oto-laryngology since 1928 are by Burt Shurly, of Detroit, and Claud C. Cody, Jr., of Houston, Tex.

Both authors stress the value of vitamins and dietetics, especially Shurly, who says "the errors of diet may not cause deficiency disease, but insidiously their gradual operation, more or less constant, may be responsible for undermining the resistance in a degree so marked that the menace is quite unappreciated. As a cause of physical inferiority, instability of the central and vasomotor nervous system, lack of recuperative power, loss of endocrine balance and lowered resistance, it (nutrition) stands out alone in the first rank." Were Shurly writing today, he would no doubt classify his cases as representing (at least) mild types of deficiency diseases.

Cody reviews the literature, submits a report on a series of 70 animals under deficiency diets A, B and D and G, and under B, says: "The characteristic tissue change in the nasal mucosa, is its polycystic appearance in the upper posterior ethmoidal region." This condition is quite characteristic of postnasal dripping in individuals who have no evidence of infection and in many instances is relieved by B therapy. He found also the incidence of acute infection among infants and children, "sharply reduced after beginning the routine use of vitamin A."

The *first reported* experimental work on deficiency diets as relates to the VIIIth nerve, with histopathological studies, was

published by T. Ono in the *Transactions of the Japanese Pathological Society* in 1928. His experiments were confined to vitamins B and C, using chickens and pigeons.

In the B studies he describes definite changes in the course of the nerve fibres, says the border of the myelin sheath is irregular, thickened and with areas of vacuolization, also splitting and degeneration of the myelin sheath. The branches to the crista acustica were most severely attacked and in the cochlea the change was most marked towards the tip. The axis cylinder to the crista, markedly swollen and serpentine, the ganglionic cells showed marked change in form and were shrunken or edematously swollen."

In the C deficiency where guinea pigs were used, the outstanding findings are hemorrhages in the drum membrane, middle ear and inner ear. Thickening of the m. t., mucosa of the middle ear, edema of the organ of Corti, and certain changes in the bony structure middle and internal ear, characteristic of C vitaminosis, *i.e.*, "atrophy lack of calcium, dilatation of the bony caniculi, tumefaction of the connective tissue cells, formation of osteophytes, fibrous marrow, etc."

OTHER VITAMINS.

Vitamin A: A very careful perusal of Mellanby's recent book on "Nutrition and Disease," recently published (1934), tells a very interesting story, among other things, about avitaminosis A, its relation to nerve degeneration in the spinal cord and elsewhere, in young dogs, during his investigation of rickets, when they showed inco-ordination of movements. The diet was free of fat soluble vitamins and had a high cereal intake and a large amount of wheat embryo." The histopathological study "revealed different degrees of demyelination of nerve tissue." Another thing, the "animals often seemed to be mentally affected." These conditions "could be prevented if butter, egg yolk or cod liver oil formed part of the diet."

He says further, "owing to the fact that the degree of inco-ordination of the experimental animals was often greater than could be accounted for by the lesions found in the central nervous system, an examination was made of the vestibular division of the VIIIth nerve." This showed much degeneration "and thus explained the excessive inco-ordination and abnormal head movements so often seen. Rather more surpris-

ing was the discovery of similar degenerated fibres in the cochlear nerve. Mellanby's comments on the degeneration of the brain and cord, multiple sclerosis, retrobulbar neuritis, the different nerves of the eye, night blindness, due to the deficiency, are illuminating, to say the least.

In another chapter in discussing beriberi, Mellanby expresses the opinion that the actual polyneuritic changes are not due entirely to vitamin B, but to vitamin A. He thinks that B₁ cures the nervous symptoms in a few hours but that "vitamin A must be given for several months to cure demyelination changes where there is an actual breakdown of the nerve fibre and myelin invasion of the axis cylinder due to its deficiency."

Mellanby offers the explanation of the work of Peters and his collaborator, that B is a necessary factor in the oxidization of carbohydrates to lactic acid and thus explains the rapid recovery from the nervous symptoms due to B deficiency. This lack of vitamin A may further explain why some cases of pellagra do not clear up on the giving of B₂. He thinks "too much attention has been focused on the skin and alimentary lesions and too little on the underlying nervous lesions which seems to me to be the basis of the whole disease."

As to *C deficiency*, as it relates to the ear, I have nothing to offer other than Ono's work, but want to say that we (Archambeault and myself) are in the process of following Harris and Ray's method of urinary titration for C deficiency and, aside from a number of allergies, have found only one ear case showing less than 20 mg. A further report will be made at a later date, at which time the findings in animals on a C deficient diet will be detailed.

As to *D deficiency*, it is my impression that many individuals of 60 years and over have a lowered intake of calcium foods, notably milk or cheese, which they are in need of, almost as much as a child, and therefore may need a supply of vitamin D in addition.

SIMMONDS AND BECKS.

In 1932, Nina Simmonds, co-author with E. V. McCollum in "Newer Nutrition," undertook a nutritional study of a small series of cases of chronic sinus disease, chronic progressive

deafness and allergy. She studied the dietary history as far as obtainable from infancy to the age of 20 years, and from 20 years to the patient's present age, taking up:

1. the carbohydrates, fat and protein intake; 2. the amounts of calcium, phosphorus, copper and iron in the food; 3. the amounts of vitamins A, B, C, D, and G; 4. whether the diets were acid ash, or alkaline ash.

Following this, Herman Becks, working on paradentosis at the Hooper Foundation, undertook determinations of calcium, phosphorus, potassium and, in a few instances; the magnesium in the blood serum and, in addition, CO_2 determinations, blood viscosity and, in a few instances, the calcium phosphorus and potassium of the saliva.

Following this, basal rates were made and in many cases fasting blood sugars and sugar tolerance tests were made. Also in a number of cases tests for protein sensitization were made, where the nasal secretions showed increase in eosinophiles. Blood hemoglobin tests were also made and, in some instances, complete blood counts. Dr. Simmonds' findings were extremely interesting, as follows:

In the *chronic sinus* cases the dietary showed: *Up to 20 years*, the *carbohydrates* were reported as fair to high, *fats*, 50 per cent were low; *proteins*, O. K. *From 20 years*, *carbohydrate* intake, fair; *fats*, intake fair, *proteins*, O. K. *For past 15 years*, showed *calcium* low in 90 per cent of the cases; *phosphorus* and *copper*, fair, *iron*, O. K.

In the *vitamin study*: *A* was low to fair. *B* low in all, *C* low in 75 per cent, two cases low to fair; two only normal. *D* 50 per cent low, 45 per cent fair. One case high. *G* 40 per cent O. K., 40 per cent fair, 20 per cent questionable.

In the *acid ash*: Alkaline ash 60 per cent were acid, 30 per cent well balanced, 10 per cent borderline.

In the *blood serum* studies: The calcium was normal in all cases but one and that one had a reading of 13.2. The phosphorus was low in the large majority, potassium low in all but one, and that was high. In other words, the calcium phosphorus, potassium ratio was low. In those checked for magnesium all were low.

Chronic progressive deafness cases (otosclerosis): From infancy to 20 years, carbohydrates high, fats low, protein O. K. From 20 years to present age, carbohydrates fair, fats fair, proteins low to fair; in the majority of cases the calcium was low, phosphorus fair, copper and iron normal.

The vitamins A, B, C, D, G, in both age groups: A, in 50 per cent was low, others fair. B, all low. C, all low. D, all low. G, 50 per cent fair, rest normal. Acid ash, alkaline ash, about 50 per cent acid.

Hemoglobin in blood, all under 82 per cent except one, which was 90 per cent.

Fasting blood sugar, normal.

Phosphorus, range 2.6 to 3.8 mg. per cent. Most cases below 3.5 mg. per cent.

Potassium, all low.

The calcium phosphorus potassium ratio in all was low.*

Basal rates: Range, between -25 and +25 per cent. Most below -5 per cent.

HAY FEVER CASES.

From infancy to 20 years, carbohydrates fair to high, fats fair, protein normal.

From 20 years to present age, carbohydrates 50 per cent low, 50 per cent fair, fats fair, protein low to fair.

Calcium phosphorus, copper and iron, calcium low, phosphorus fair; copper fair to normal.

Vitamins A, B, C, D, G: A, low; B, low; C, low; D, low; G, fair.

Acid ash, alkaline ash, about equal.

Blood serum, calcium phosphorus normal; potassium in all cases low. There the C/P ratio was low.

Regarding the the almost constant finding of a low Ca P.K. ratio by Becks, in his blood serum studies, no conclusions can be drawn, largely because so very little is known of the exact part played by potassium salts in the body.

*Ca method Kramer and Tisdale. P method Flisk and Subbarow. K. method Kramer and Tisdale.

The electrolyte balance probably has to do with the acid base balance, and no doubt plays a part at least in the proper balance of the autonomic system and yet aside from Zondek's work, no further proof has been presented.

Dean and Wenner think potassium is a para-sympathetic stimulant and yet Professor Cannon of Harvard and Professor Wiggers of the University of Ohio, in personal communications do not support their contention.

I might say at this point, that work already begun by Professor C. L. A. Schmidt in the Department of Biochemistry, University of California, on potassium may be solved in the next two years, and it is hoped this work will clear up the many uncertainties concerning the part it plays in the human body.

OTOSCLEROSIS AND THE EIGHTH NERVE.

Up to the present nothing much is known or has been written about (that I've been able to find in literature), aside from the work of Crockett and Aub, some years ago, when they published their calcium diet studies, that may play a part in checking the progress of the deafness found in otosclerosis or in nerve deafness, except that occasioned in the latter, by focal infections or drugs, described by various writers, notably Duel and others.

As far as otosclerosis is concerned the degeneration of the nerve is most important as I see it, and I cannot help agreeing with the notion expressed by Gray, that it is nutritional disease, depending on altered function of the vasomotor nervous system, and that the bony changes at the footplate of the stapes and in other regions are due to a trophoneurosis, and the change in the bone may not occur for a long time.

Shambaugh, Sr., has often spoken of patients exhibiting at the beginning a typical nerve picture and 20 years later presenting definite functional tests of an otosclerosis. The question naturally arises, cannot the progress of the degeneration of the nerve be held in abeyance, through constitutional treatment? I believe such a course is at least worthy of trial instead of telling the victim that nothing but lip-reading and the use of an audiphone, are the only help at hand.

During the past six months we have seen 35 cases, with nerve deafness predominating, 10 under the age of 50; five in the early 50's; 20 from 60 to 82 years of age, and, according to George Shambaugh, Sr., some can be classified as otosclerosis. The studies of these cases will be elaborated in a subsequent paper.

In this study, Wm. Weston's classification of the vitamin containing foods has been followed, also a questionnaire used by Dr. Simmonds in her nutritional studies in the Department of Dentistry, University of California.

TAKEN FROM VITAMIN CHART BY WM. WESTON AND HAROLD LEVINE, M.D.

xxx Check for foods eaten daily or several times weekly.

xx Check for foods eaten occasionally, as once weekly.

x Check for foods eaten rarely or less than once weekly.

The following foods are the best sources of:

VITAMIN A.

MOST POTENT	GOOD	
Cod liver oil	Cream	Pumpkin, yellow
Halibut liver oil	Cheese	Squash
Salmon liver oil	Egg yolk	Sweet potato
	Liver	Tomato
EXCELLENT		Avocado
Apricots, fresh	Asparagus, green	Bananas
Carrots	Beans, green	Cantaloupe
Collards	Cabbage, green	Oranges
Escarole	Chard	Peaches
Lettuce, green	Cloverhay	Prunes
Spinach	Corn, yellow	Clams
Turnip greens	Kale	Kidney
Watercress	Peas, dried green	Milk (whole), fresh or
Butter	Peppers, green	dried or evaporated

VITAMIN B.

MOST POTENT		
Dried brewers yeast	Carrots	Grapes
Wheat germ	Cauliflower	Grapefruit
	Celery	Lemons
EXCELLENT	Collard	Oranges
Beans, ripe	Lettuce	Peaches
Cereal grain (whole)	Onion	Pineapple
(Mainly in the germ	Parsnip	Prunes
and bran)	Potato	Strawberry
Nuts	Spinach	Brains
Peas, ripe	Tomatoes	Cheese
Wheat middlings	Turnips	Eggs
Wheat bran	Turnip greens	Fish roe
	Apples	Kidney
GOOD	Bananas	Liver
Asparagus	Cantaloupe	Milk
Beans	Dates	Oysters
Cabbage		

VITAMIN C.	
MOST POTENT	Peas, green
Raw cabbage	Rhubarb
Lettuce	Turnips
Paprika	Citron juice
Spinach	Lime juice
Tomato	Pineapple
Watercress	Peppers, green
Grapefruit	Raspberry
Lemons	Strawberry
Oranges	Tangerine
EXCELLENT	GOOD
Celery	Beets
Onion	Cabbage
	Carrots
	Cauliflower
	Collards
	Cucumbers
	Endive
	Peas, cooked
	Potato
	Pumpkin
	Spinach, cooked
	String beans
	Sweet corn
	Sweet potato
	Turnip greens
VITAMIN G.	
MOST POTENT	Turnip greens
Yeast	Watercress
Liver	Wheat germ
Kidney	Egg
Spleen	Haddock
Lean meat	Milk
EXCELLENT	Salmon
Beet greens	GOOD
Kale	Bananas
Potato	Beets
Spinach	Cabbage
	May peas
	Cottonseed meal
	Turnips
	Soy bean
	Citrus fruits
	Lettuce
	Onion
	Tomato
	Oysters
VITAMIN E.	
MOST POTENT	Barley
Wheat germ oil	Corn (whole)
EXCELLENT	Molasses
Lettuce	Oat (whole)
Watercress	Oils (vegetable)
Wheat germ	Cottonseed
GOOD	Corn
Peas	Peanuts
	Rice (whole)
	Wheat (whole)
	Meat
	Egg yolk
	Milk

Dr. Simmonds' resumé is as following:

Please state whether at the present time you eat sparingly (S), moderately (M), or freely (F), of the following foodstuffs:

Meat	Fish	Bread white— whole grain	Fruit, name favorites	Cheese	Eggs per week	Butter
Milk (glasses daily)	Cocoa or choc- olate (cups daily)	Potatoes	Tomatoes raw, cooked	Vegetables cooked, salad		
Fresh buttermilk						
Cereals, name favorites	Tea cups daily	Coffee cups daily	Cakes	Pies	Rich pastry	
Cigars No. daily	Cigarettes No. daily	Do you smoke a pipe? No. daily		Any other items		

The use of these lists gives one a fair idea of the patient's general dietary, especially the vitamin intake, and seemingly furnish a fairly definite clue as to the fundamental deficiencies, so much so that applying the findings to the present group of cases has brought results sufficiently encouraging to warrant experimental work in a group of white rats. The latter work was started by a bright young chemist, Robley Archambeault, in the animal laboratory of the Southern Pacific General Hospital, San Francisco, June, 1935. In this animal group, 16 were on B₁ deficiency diet, 14 on B₂, and 12 were controls.

Since the writing of this paper, Dr. Wm. Covell, of the George Williams Hooper Foundation for Research Medicine in San Francisco, reports in a preliminary histopathological survey of several rats on an acute B₁ deficiency diet, as follows:

- a. Probably a beginning nerve degeneration, which was not sufficient to blacken segments and droplets of myelin, but instead render them only suggestive. It is possible that enough time had not elapsed between the appearance of the symptoms in the animal and its death.
- b. Edema about the structures (nerve and spinal ganglia) in the modiolus.
- c. Spiral ganglion cells and hair or sensory cells revealed changes suggestive of an early stage of degeneration.
- d. Stria vascularis appeared normal.

This study of chronic deficiency in animals is being continued.

The outstanding result in this first group was the very definite evidence of inco-ordination (apparent vertigos) in those on B₁ deficiency. It is our purpose to repeat this experiment and, later on, run a series of A and C deficiency, a report of which will be made later on, and it is hoped that funds will be available to continue these studies on a larger scale in the Departments of Biology and Biochemistry under Professor Herbert Evans and Professor C. L. A. Schmidt, and that further studies on the hearing of animals on deficiency diets can be carried on by Dr. Covell, of the Hooper Foundation, along with histopathological studies, to determine the pathology present.

CASE HISTORIES.

The following cases, two definite otosclerotics, two nerve cases, are reported in some detail, in order to illustrate to some extent the difficulties encountered in the studies. It is to be noted that in Case 4 there is a definite allergy encountered, and in Case 2, while no positive allergy was recognized by testing, her nasal secretions showed a considerable increase in eosinophiles.

Case 1: Miss Z. L., age 36 years. Diagnosis: Otosclerosis, by two well known otologists.

The outstanding facts about this patient are: 1. Deafness beginning about the age of puberty. No inherent history of deafness, other than a cousin on the father's side, who is said to have the same type of deafness. 2. She was a November baby, born on a farm in Minnesota and probably, according to Simmonds' report, had infantile rickets before she was four months old. A bad nutritional history most of her life. 3. Marked vasomotor instability. 4. A suggestion, as reported by her physician, Dr. Ernest Falconer, of hypofunction of pituitary, and also some evidence favoring thyroid hypofunction. He says: "I am inclined to regard the thyroid hypofunction as being primarily due to a deficiency of the thyrotrophic substance of the pituitary gland" (H.M.R. -23 per cent). He thinks she "had a functional hyperactivity of the pituitary in the past, possibly in childhood and early adolescence, but that now there is an exhaustion or low pituitary function, leading to a general asthenia, as is shown in her low blood pressure, which seven years ago was 80/50. In 1933 it was 95/60." Low blood sugar (68.9 mg.), low hemoglobin 76 per cent.

Her nutritional study by Dr. Nina Simmonds, is as follows: *Since 20 years of age*, the carbohydrate intake has been fair, fats fair, protein low. The calcium intake is low, phosphorus fair; copper and iron, questionable. *Vitamins: A* is low; *B* is low; *C* low to fair; *D* low; *G* possibly sufficient. *Acid-alkaline ash*, probably acid. The *electrolytes*, Ca, 9.9; phosphorus 3.6; K 16.95.

Case 2: Mrs. C. O'S., age 40 years. Diagnosis: Otosclerosis. Born in San Francisco. Family history of deafness. Brother, sister, father, grandfather and great grandfather, were deaf. Noticed beginning deafness at age of 28 years, became definite-

ly worse after the birth of second child. Does not hear better in noise. Has had measles, scarlet fever, mumps, whooping-cough. No ear trouble in childhood. In recent years, has had frequent colds. X-ray of sinuses showed marked thickening in right antrum, and ethmoid; left antrum and ethmoids appear fuzzy. *Operations:* Strabismus, tonsillectomy, appendectomy, resection of septum. *General.* Complaint: Frequent colds, lack of energy, attacks of diarrhea. Marked tremor of hands, nervousness, deafness. *Laboratory studies:* B.P. 105/72, low sugar tolerance; blood count, secondary anemia. B.M.R. +5 to +15. *Marked* vasomotor instability. Nothing otherwise important in general look over.

Dr. Fred Kruse, who studied her generally, comments as follows: "It is quite possible that all these conditions have been brought about by an overactive nervous system, a lowered resistance to infections, a poor diet or a diet poor in vitamins, phosphorus and calcium through childhood. When first seen the conditions suggested hyperthyroidism, although showing no evidence of thyroid enlargement." Subsequently, the giving of magnesium resulted in almost complete cessation of the tremor.

Nutritional study. From infancy to 20 years of age: Carbohydrate fair to high; fats low; protein O. K. *From 20 years of age to present time,* carbohydrates, fats, protein *not excessive.* *Vitamins* A, B, C, D, low. G, O. K. *Acid-alkaline* ash, fairly well balanced. *Electrolyte* study, Ca. 9.75. Phosphorus 3.25. K, 13.8 (very low). Mg. 1.3 (low).

The beneficial effects following the use of Scheffelin's glycortal pills (glycerinated extract of the adrenal cortex) in large doses, which not only brought the blood pressure to 125, but lessened the fatigue. It suggests, naturally, that the cortex was functionally below normal, and might have played a large part in her general condition.

NERVE CASES.

Case 3: Mrs. G., age 34 years. *Diagnosis:* Nerve deafness. Seen March, 1933. Referred for consultation. History of having noticed deafness in right ear for the past three years, low pitched tinnitus. Had infected tonsils and one abscessed tooth. Previously had two abscessed teeth removed.

Nutritional study. From infancy to 20 years of age: Carbohydrates probably higher than most people, due to circumstances, fats low, protein O. K. *From 20 years to present time,* carbohydrates low; fats low; protein O. K. Food, calcium low. Phosphorus, cu. and fe. fair. *Vitamins,* A, fair; B, low; C, low to fair; D, low; G, fair. *Acid alkaline ash,* "probably well balanced since she is not eating much meat and cereals, and is using fruits and vegetables." *Electrolyte study,* Ca. 10.25. Phosphorus, 3.6. K, 11.6 (very low).

Hearing recheck Aug. 16, 1935, shows a gain of 10 per cent in the two years since tonsils and teeth were removed. This gain may be just the normal variation in hearing and should be checked repeatedly. The original loss undoubtedly was due to an infection, secondary to nutritional deficiency and may be permanent. The patient has quite recently begun a treatment, to correct her deficiencies, and the results will be reported at a later date.

Case 4: J. A. E., age 42 years. Diagnosis: Nerve deafness. First consulted me in 1925, for asthma. His testing showed him sensitive to several foods, and to his own feather pillow. Changing to a silk floss pillow and eliminating the foods he was sensitive to, gave him complete relief, except when he slept on feather pillows or ate the forbidden foods. He also complained of sneezing and stoppage of left side of his nose, and deafness in left ear. *Examination of nose* revealed a deflected septum and polyps. Correction of the septum and an ethmoid operation has relieved his nasal condition. When rules were broken, secondary infection ensued.

Audiometric test revealed a nerve deafness worse in left ear. Had an appendectomy in 1934, following which the hearing in right ear has improved, and the upper limit as of 1933 has increased from 8192 v.s to 12,000 v.s. Hearing in left ear has decreased.

Dr. Edwin Bruck who made a thorough physical examination, and reported him as a rather small man, definitely undernourished, and who looked bad generally. The outstanding conditions were a bilateral arcus senilis, some tremor of hands. Marital incompatibility, coupled with business strain in rather a high strung individual, subject to emotional outbursts, caused a nervous breakdown some months prior to being seen by

Dr. Bruck. Blood count: Wassermann were O. K. but H.M.R. was -5 per cent. Gastric analysis showed low hemoglobin. Blood pressure 110/120 but had been low.

Dr. Becks' report on his blood serum was as follows: Total serum calcium, 9.85; phosphorus 3.8; magnesium, 1.5; CO_2 C P ratio 62.0; viscosity. The cause of the low K and mg. is undetermined. The fact that he improved markedly under Delbiase four halogen salts of magnesium, so far as his tremor and nervousness were concerned, is interesting.

Nina Simmonds' first nutritional study says "patient knows good food and has always taken generous amounts of food which would supply calcium, phosphorus, and other minerals, and vitamin. Do not see how his trouble could be related to his diet in any way, unless it would be a matter of lack of assimilation due to years of being under strain, lack of sleep, worry, mental strain, etc., which have undoubtedly played their part in his present condition."

Since his first nutritional study, a further and very recent interview has developed into quite a different story and indicates that for at least 25 years of his life his diet has been deficient in vitamins A, B and C, and evidently during these years his carbohydrate intake has been excessive.

The presence of arcus senilis in a comparatively young man, the fact that both parents, brothers and sisters had defective teeth, and that he himself had been under a dentist's care for 30 years for soft teeth, four having been extracted because of pyorrhea and showing at present four dead ones, with many fillings in the remainder, rather suggests that his nutritional state must have been below normal, and that his dietary factors certainly must have been out of line during his adolescent period.

What part an infection of his tonsils, teeth and sinuses may have played in his damaged nerve, is uncertain, though it is possible it had considerable effect upon it. At the same time his nutritional factors may have prepared the way for his nerve involvement, secondarily.

This case illustrates the difficulty in getting a positive lead, in a nutritional review, and suggests in Simmonds' first interview, that he inadvertently may have dipped a bit into romance.

CONCLUSIONS.

The following points are submitted: 1. That the literature quoted and unquoted furnished sufficient evidence that many diseases of man have defective nutrition as a background.

2. That there is a slowly accumulating evidence that lowered nutrition furnished the basis for the claim that certain diseases of the ear, nose and throat come within the classification of partial deficiency states.

3. That affections of the perceptive organ of hearing aside from toxic neuritis have a definite relation to deficiency states.

4. That attention to an optimum nutrition can delay the progress of VIIIth nerve degeneration, if faults of nutrition are recognized in early life and carried out throughout the life of the individual.

5. That it is possible after the fifth decade of life, to ameliorate the condition of the individual's hearing, provided the areas of voice perception, *i.e.*, between 240 d.v. and 4096 d.v. are not hopelessly damaged.

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Fitzghugh Bldg.

BACTERIOPHAGE THERAPY IN NASAL AND AURAL DISEASES.

DR. SIMON L. RUSKIN, New York.

So conflicting have been the reports on bacteriophage therapy that one approaches a consideration of its value with considerable trepidation. Add to this the fact that adequate clinical control is practically impossible because of the number of uncontrollable factors and one has sufficient reason to avoid making statements that are dogmatic. Nevertheless, in spite of these factors, one can obtain a sound opinion based on prolonged experience and continued use over a period of years. Such is the approach here presented. It would be simple for one to record a large series of cases with detailed reports of the improvement experienced, but a similar record can be shown for almost any type of treatment recorded, from nasal irrigation with saline solution to ultra short wave, or anything more recent. Instead, I wish to report my own impressions accumulated over a period of two and one-half years, during which time, with the sincere co-operation of one of the pharmaceutical companies, approximately 20,000 2 cc. ampules were supplied to me for experimental office use. During 1933, 1934 and 1935 four types were used: All of the D'Herelle type, *Rhinobactephage*, comprised of bacteriophages of streptococcus hemolyticus; staphylococcus aureus, albus, citreus, pneumobacillus; proteus bacillus; para coli bacillus, B. Pyocyaneus. *Staphybactephage*, consisting of each cc. containing 10,000,000,000 bacteriophagi capable of bacteriophagic destruction of various varieties of staphylococci (aureus, citreus and albus), together with the dissolved substance of 250,000,000 staphylococci utilized by the bacteriophagi for reproduction and increase. *Pyobactephage*, composed of mixed phages of species occurring in suppurative processes, together with the dissolved substance of bacteria utilized by the bacteriophagi for reproduction and increase; and *intestibactephage*, comprised of mixed intestinal types. The last I used as a sort of control to

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see whether there was any difference between the more specific type and the nonspecific groups. This gave a basis for judgment as to whether the lysed bacterial proteins were useful as a nonspecific protein therapy, in the form of a Besredka vaccine pack.

The factors which I wanted to judge were: 1. The value of bacteriophage as a preventive of recurring nasal infections. 2. The influence of bacteriophage therapy in acute infections. 3. The benefits of bacteriophage in chronic infections. 4. Systemic reactions to bacteriophage. 5. Factors influencing the action of bacteriophage. 6. The best method of its application.

The value of bacteriophage as a preventive of recurrent infections was found to be dependent upon almost continuous use of the phage. During the active use of the bacteriophage, patients with chronic suppurative sinusitis were definitely less subject to recurrent exacerbations and seemed to be much less susceptible to colds with recurrence of the sinusitis. Stopping the use of bacteriophage brought with it the same susceptibility to reinfection as that existing previous to treatment, leading to the conclusion that the lytic element tends to disappear within a few weeks after the discontinuance of its use. Patients of this type were instructed to start use of the phage as soon as there were any signs of the onset of nasal congestion or the feeling of a beginning cold. Under this form of bacteriophage use, the incidence of moderate or severe sinus infections was definitely reduced. So beneficial did this prove that many of the patients keep an adequate stock of bacteriophage with them, both at home and when traveling.

The patients that seemed to benefit most from the bacteriophage were those who had had previous sinus operations. Following its use there was observed a diminution in congestion of the mucosa and recession, with some disappearance of nasal polyposis. Particularly in ethmoid and sphenoid cases, where the site of the operation had become obscured by moderate edema and polyposis of the sinus mucosa, the cavities would again become visible and after several weeks take on a clean, healthy appearance. Postnasal discharges were diminished and in many cases completely stopped. These cases I would classify as the type most helped by bacteriophage therapy.

The second group of cases, representing acute infections, would be divided into the ordinary acute rhinitis and the acute sinusitis. The former, usually considered as the common cold, were benefited only if treatment was instituted prior to the onset of nasal obstruction and profuse discharge. For this group the patient was instructed to use the bacteriophage when discomfort became apparent in the nasopharynx and was associated with moderately tenacious mucus dripping from the back of the nose into the throat. This, I find, is a premonitory symptom of the onset of the common cold. At this stage it is possible quite frequently to abort the "cold." When once the acute symptoms have made their appearance the phage instillation alone has been of little use. It appears that the presence of nasal secretion inactivates the phage. In some of the acute cases I followed the technique of decongestion of the nasal mucosa by packing with cotton tampons, similar to the Dowling pack, soaked in bacteriophage, for 10 minutes, followed by careful aspiration of all secretion. I then cocaineized both sphenopalatine ganglia for one to two minutes to a point where the mucosa shrinks enough to open up the meati. I then sprayed about 2 cc. of the bacteriophage into the middle and superior meati. This technique gave gratifying relief of the acute symptoms. The patient was instructed to instill about 10 to 15 drops of bacteriophage into each nostril every two to three hours subsequently. With this treatment I have found the course of the acute cold to be materially shortened.

For the treatment of acute sinusitis the same routine is employed, supplemented by such additional treatment as the individual case requires.

I would, however, emphasize the point that nasal secretions should be carefully removed prior to the application of the bacteriophage.

The third group of cases, representing the chronic sinusitis, were those requiring the most careful study. Unless the underlying etiologic factors inducing chronicity were located and eradicated, the use of bacteriophage was disappointing. The first large group that must be eliminated were the cases of nasal allergy. Particularly in children, recurrent attacks of so-called colds and sinusitis were really the first appearance of nasal allergy that had been unrecognized as such. They benefited not at all by bacteriophage and showed the allergic

reason in skin testing. This factor deserves emphasis because the financial expense incident to a proper investigation of allergic sensitivity is an obstacle that middle-class patients do not like to face in these times.

In antrum infections the sources of chronicity were not materially benefited by bacteriophage therapy. Instillation of bacteriophage into the maxillary sinus was not attended with any particular improvement. I find that undetected dental infection was the most frequent cause of the chronicity. A misleading report of the dentist attending the patient is the most usual source of failure. It would be a severe statement to say that in the presence of persisting isolated maxillary sinus infection no single dentist's opinion of the absence of dental infection should be relied upon.

Better results with bacteriophage seem to attend frontal, ethmoid and sphenoid infections.

Any systemic reactions to bacteriophage were not apparent. Patients who had used several hundred ampules during the course of three years manifested no gastric or other symptoms. In small infants 2 cc. every three hours caused no evidence of any disturbance.

With the use of bacteriophage as a nasal packing repeatedly twice or three times a week, no tendency toward an immunizing effect, either towards the common cold or recurrent infection was observed.

Parenteral injection of bacteriophage likewise showed no immunizing effect, although at times a tendency for improvement in protracted acute cases was occasionally observed.

In mastoid infections, with threatened intracranial complication, irrigation of the mastoid cavity, flushing the bacteriophage through the antrum, sufficiently to allow the escape of the phage through the middle ear and Eustachian tube, was employed. This procedure, I found of marked value in six cases. In these cases 50 cc. of phage was used three to four times a day.

Perhaps the most important single rule in the use of bacteriophage is the use of large amounts. Adequate daily treatment for nasal use would be between 6 to 10 cc. Unfortunately, from the economic standpoint, this is frequently a trial to the patient.

In the use of bacteriophage I would caution against: 1. The continued use of bacteriophage with other forms of treatment employing antiseptics that would inactivate the lytic agent; 2. the presence of secretions; 3. inadequate volume of bacteriophage.

Control use of nonspecific bacteriophage, such as the intestinal phage in nasal packs, were not attended with any of the results observed with either the rhino, staphylo or pyobacte phage types.

Among those cases treated benefit to be derived from this form of therapy would be apparent in about a week to 10 days. Purulent discharges would take on a mucoid appearance and the patient would experience a sensation of dryness in the nose. Where the bacteriophage was not effective no such change was apparent and this form of therapy was promptly stopped. Cases that did not respond fairly quickly did not respond at all. Such benefits as were derived were probably from group lytic phages.

The specificity of bacteriophage for definite strains of organisms and its complete lack of lytic action on other strains of organisms must be borne in mind. The chronic purulent staphylococcic type of nasal infection seemed to give the best response. This is in accord also with the findings of observers in other fields such as the skin infections reported by Eaton and Bayne-Jones, (*Jour. A. M. A.*, Dec. 8, 15, and 22, 1934).

CONCLUSIONS.

1. Bacteriophage therapy has been of value in diminishing recurrent acute nasal infection while in relatively continuous use. When treatment was discontinued recurrences were about as frequent as usual.

2. Bacteriophage therapy was useful in acute infections when used with the described technique.

3. Maxillary sinus infections were less frequently helped than that of the frontal, ethmoid, or sphenoid sinuses.

4. Bacteriophage therapy required the avoidance of combined use with chemical antiseptic remedies, the removal of secretions and a liberal amount of the bacteriophage.

351 West 86th Street.

THYROXINE IN THE TREATMENT OF OTOSCLEROSIS. PRELIMINARY REPORT.*

DR. MAX A. GOLDSTEIN, St. Louis.

On May 3, 1935, Dr. Albert A. Gray, of London, presented to the Section on Otology of the Royal Society of Medicine his "Treatment of Otosclerosis and Similar Types of Deafness by the Local Application of Thyroxine."

He reported 14 cases treated by this special technique and therapy in which seven showed very considerable improvement. This included a reduction in tinnitus, recurrence of cerumen secretion and actual improvement in hearing.

In August, 1935, I visited Dr. Gray at the Ferens Institute, Middlesex Hospital, London, and had the privilege of seeing him apply this technique and therapy in three cases.

Whenever a new technique is suggested and published in the medical press, there may always be some detail not clearly comprehended by following the printed description.

The purpose of this preliminary report, therefore, is to record my own observations on a first group of four selected cases in which I have undertaken this therapy since my return and to offer my personal observations on the technique as I found it applied.

While the details of technique are carefully described in Dr. Gray's paper there are some niceties connected with such a delicate manipulation as anesthesia and puncture of the drum membrane, the preparation of a tabloid for injection through a fine needle and the careful measurement of sound capacity before and after treatment, which should be emphasized in this procedure and thereby enhance its value.

In 40 years of otologic practice I have never succeeded in securing a complete and safe anesthesia of the drum membrane. Gray uses a 10 per cent solution of cocaine in aniline oil for this purpose. Aniline oil has a peculiar penetrating property

*Read before the Mid-west Section of the American Laryngological, Rhinological and Otological Society, St. Louis, Jan. 15, 1936.

on epithelial surfaces in that it dilates the stomata between the individual epithelial cells, thereby making possible the penetration of the cocaine; it also has the dangerous factor of quick absorption and the possibility of aniline poisoning. I had one such experience in my own practice many years ago when I used aniline oil with cocaine to ameliorate pain in a case of acute otitis. In a simple and effective manner Gray obviates this difficulty by first securing anesthesia after five-minutes' instillation of from 15 to 20 drops of freshly prepared solution of this anesthetic and then carefully wiping the canal dry to the fundus with pledgets of cotton before making the injection. In this simple manner all possibility of aniline oil absorption is avoided.

The tabloid thyroxine used in this technique is of definitely measured dosage and is tincturated in a sterile watch-glass with 4 mm. of distilled water. On the fineness of this pulverization depends the success with which this preparation of thyroxine in suspension is injected through the fine-calibered needle into the middle ear.

Another matter of considerable importance is the point of selection for the puncture of the drum membrane. This should be half-way between the end of the malleus handle and the periphery of the drum membrane in the posterior-inferior quadrant. The direction of the needle should be slanted backwards and inwards so that the point of the needle may pass beyond the bony lip of the round window and thus escape impaction on the promontory. This will also avoid, to a great degree, puncturing some minute blood vessel that may cause a slight clot at the site of injection.

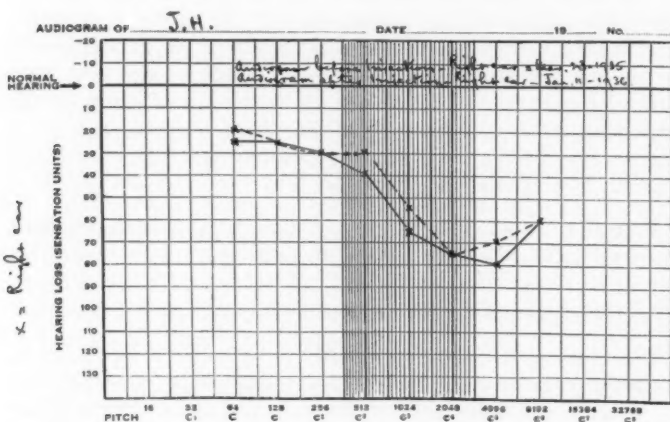
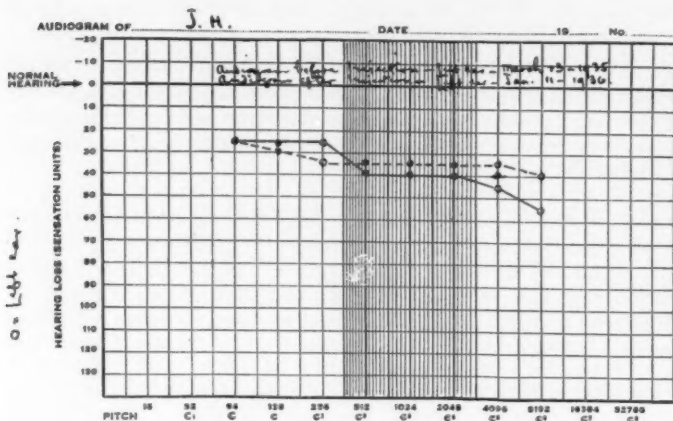
Immediately after the injection the patient's head is bent far backward and the mouth opened wide for about five minutes to prevent the injected fluid from trickling through the Eustachian tube into the nasopharynx.

There seems to be some difficulty in securing in the U. S. A. tabloid thyroxine preparation especially indicated by Gray as the therapeutic agent that he has selected for this treatment, and it makes it rather difficult for those of us interested in checking up on this therapy to secure the necessary supplies.

Conservatism in the functional tests of hearing before and after this treatment has thus far excluded the use of a recog-

nized form of audiometer and the consequent audiogram for comparison.

Gray still confines himself to the use of the tuning forks, the watch and conversational and whisper voice in making his comparative estimates of hearing improvement.

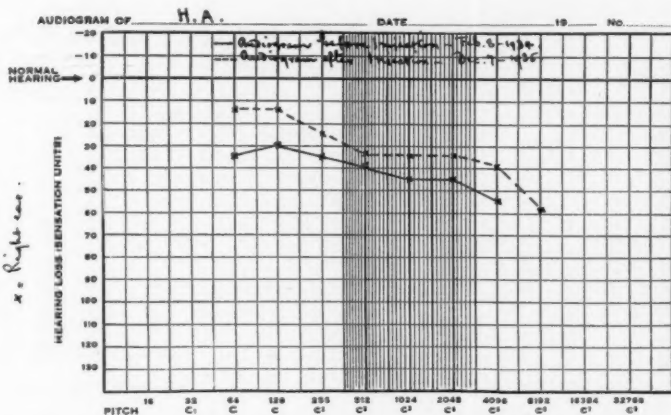
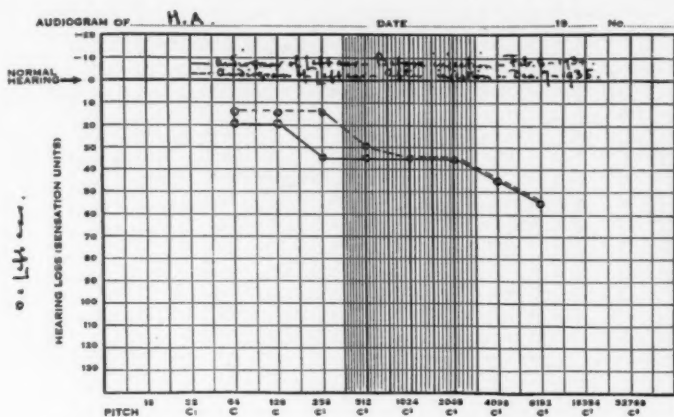


REPORT OF FOUR CASES.

Case 1: J. H., male, rural mail carrier, age 32 years. Mother hard-of-hearing at 40 years. Defective hearing began in 1929. Tinnitus in right ear a constant accompaniment; no tinnitus in left ear.

Considerable vertigo one year ago; this is now definitely diminished but still noticeable when rising suddenly from recumbent position.

Nystagmus reaction bilateral practically normal. Injury while diving when 12 years of age, including trauma left forehead with scar still presenting and earache on same side persisting for a week or two. Paracusis positive and persisting until time of injection.

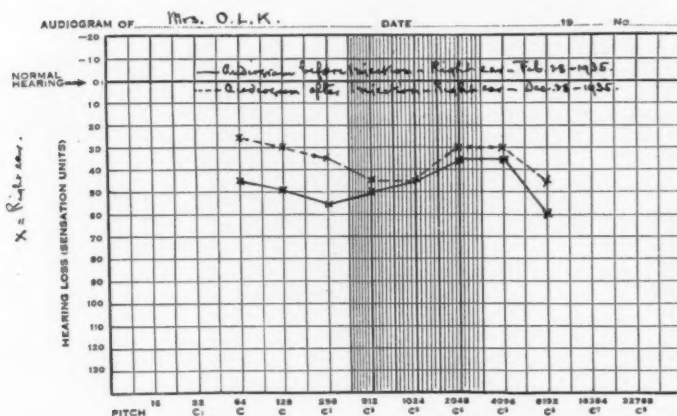
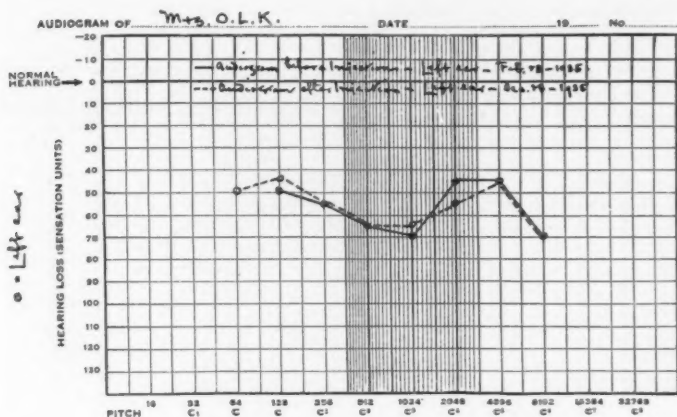


Tuning Forks: Rinne negative R. and L., Weber lateralized to right.

After first injection patient reports no noticeable improvement in hearing and no abatement of tinnitus; slight fullness in ear lasting about 24 hours. Slight fever following injection and could hardly hear at all for about 24 hours.

Second Injection: Improvement in hearing and head feels clearer than it had for two or three years (refer to letter).

Third Injection: Improvement in hearing continues; head feels clearer and tinnitus reduced. At no time has there been any pain or discomfort.



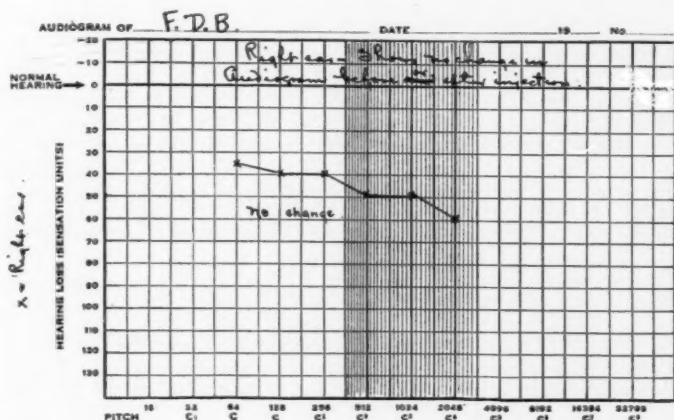
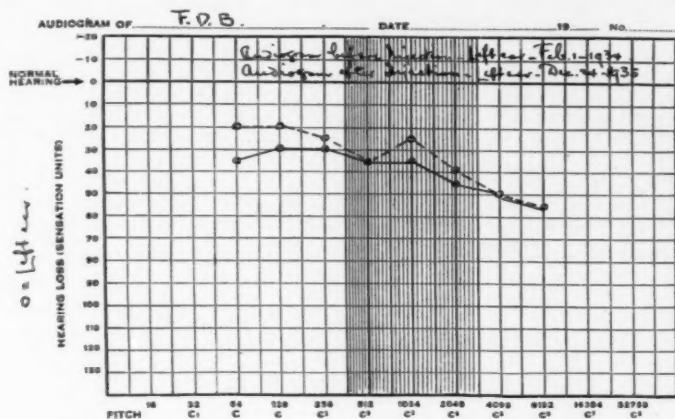
Another comparative test made by patient was his ability to hear a clock on the mantel in the postmaster's office clear across the room. This he had been unable to hear for many months.

Case 2: H. A., female, teacher, age 28 years. No familial history of deafness. Onset of defective hearing gradual; first noticed about three years ago and two years ago was unable to hear watch tick. Rinne bilateral negative; Weber not lateralized; acoumeter 10 inches R. and L.

Right m.t. normal in plane, shows pink spot about manubrium. Left m.t. negative; nose and nasopharynx negative.

Tinnitus on high pitch (about 4096 d.v.), constant for past two years. Paracusis positive.

First injection Oct. 12, 1935. This patient is a very intelligent observer and it is interesting to quote from her report to me as follows: "First



injection in right ear produced a most appreciable difference. Immediately after it was made I went home and alternately read and slept all afternoon, a procedure which I followed after each injection. For the rest of the working hours the right side of my head was numb and my ears deafened. The following morning I awoke to find my hearing remarkably

clear, especially the left ear. I was so amazed at hearing a bird sing that I held my noiseless clock to my left ear and heard it tick for the first time; the right ear could not even feel the ticking.

"Forty-eight hours after injection the feeling progressed until by afternoon I was comprehending words in a tone that I could never have comprehended the week before. The lumbering, thundering, pounding tumult had subsided, leaving only the clear hissing.

"The second injection, left, apparently left no good results because much of my former deafened condition returned as did the deadness about the ears; this may also be said of the third injection.

"After the fourth injection the ears remained in the same condition for about 48 hours, so that I had come to the conclusion that injections in the right ear benefited the right ear somewhat and the left ear greatly while injections in the left ear had a retrogressive effect. A week later I noticed a change in the hearing in both ears; the ticking of the clock could be heard through the left ear even a short distance away while the right ear perceived the ticking when the clock was held against it.

"Today, about six weeks after the first injection, I am hearing conversation more easily; sounds are reaching me from greater distance; the ears and surrounding areas no longer seem deadened, and I have not suffered from one headache, an unprecedented stretch as far as my adult years are concerned."

Case 3: O. L. K., female, housewife, age 26 years. No familial deafness. Repeated earaches during childhood following swimming and diving; defective hearing first noticed about three years ago and gradually increasing.

Speech sounds seemed muffled and often confused. Rinne negative R. and L.; Weber not lateralized. Eustachian tubes R. and L., reduced lumen; drum membranes retracted. No tinnitus at any time. Gelee negative R. and L.

Neither clinical examination, functional tests nor audiogram would indicate definite diagnosis of clinical otosclerosis. Catheterization and other mechanical treatment has shown no appreciable change in hearing capacity.

Reported effects of injections in this case show no marked change in hearing capacity although remote sounds, i.e., telephone, door bells and telephone bells, and conversational voice are perceived with more clarity.

Case 4: F. D. B., male, clerk, age 32 years. Analysis of audiogram in this case would indicate either nerve deafness or beginning otosclerosis, as the upper pitch range limits (4096—8192 d.v.) were not heard in the right ear and the lower pitch range (64 d.v.) was hardly perceptible in that ear.

Tuning Forks: Rinne right ∞ , left +. c-5 fork, right negative C fork (64 d.v.), reduced hearing.

Eustachian tubes R. and L. patulous; m.t. R. and L., somewhat retracted.

This patient does considerable flying and offers this as the possible etiology of his defective hearing. Here, too, we are not entirely justified in a definite diagnosis of clinical otosclerosis.

Following the fourth injection in this case there was a temporary marked deafness in the left ear lasting about 48 hours; this cleared up without further sequence.

After treatment audiograms show no appreciable improvement in hearing though patient states noises have been considerably reduced.

I discussed this treatment with some of the senior otologists in London who were present when Gray made his presentation before the Section on Otology of the Royal Society of Medicine and got their first reaction on this new therapy and technique. The consensus of opinion was that if it had been suggested by a colleague of less experience in the intricacies of otosclerosis and less conservative than Gray, the favorable reports of hearing improvement and tinnitus reduction might have been more dubiously accepted.

My own experience with the four cases here reported not only tends to corroborate the observations of the originator of this technique and therapy but I have also added another feature in the determination of comparative results in hearing, both before and after treatment, in the careful preparation of the audiogram; these audiograms speak for themselves.

In recent correspondence and discussion with Gray and an exchange of experiences, he emphasized the fact that the cases selected for treatment should be comparatively young otosclerotics (under 40 years of age), and where the hearing deterioration has not been so marked that comparative tests may become difficult.

Finally, the most significant features in this therapy are:

1. The first series of cases reported by Gray were injected almost one year ago and where hearing improvement has been noted, the same degree of hearing improvement noted shortly after the treatment has been maintained.
2. Even where no improvement has been noted in the cases injected no untoward symptoms of any kind have presented themselves.
3. The technique is simple, painless and incapacitates the patient in no manner whatsoever.
4. The degree of improvement is variable; in several cases there may have been comparatively little improvement in actual hearing, but the reduction in tinnitus in these cases has made possible less confused and better sound perception. The audiogram, however, must verify the actual change in physiological hearing.
5. The most definite improvement noted seems to be in the lower tone frequencies of the speech range or, as the patients express themselves, "clear comprehension of ordinary conversational voice."

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AUDITORY FUNCTION STUDIES IN AN UNSELECTED
GROUP OF PUPILS AT THE CLARKE
SCHOOL FOR THE DEAF:

II. CLASSIFICATION ACCORDING TO TYPE AND
LEVEL OF GRAPH BY AIR
CONDUCTION.*†

DR. RUTH P. GUILDER and LOUISE A. HOPKINS, B.A.,
Northampton, Mass.

As the result of a comprehensive investigation of hearing acuity with the amplified 2-A audiometer in a group of 100 unselected pupils at the Clarke School for the Deaf, a general survey and statistical analysis has already been presented.¹ Mean curves and frequency distributions by air and bone conduction for the entire deaf group and the principal etiological subgroups were established. The controlled conditions, under which all tests are carried out, the periodic tests given to all pupils, and the amplified 2-A audiometer used throughout the investigation were described in detail.

In the present study, we wish to consider the analysis of these data from the standpoint of type and level of graph by air conduction. We will consider first the characteristics of the four principal types of graphs presented by pupils in a school for the deaf, with three subdivisions according to the level of the graph or amount of residual hearing. Then, on the basis of this classification, we will analyze these four classes and their three subdivisions according to hearing acuity by air and bone conduction and etiological composition.

CLASSIFICATION ACCORDING TO TYPE AND LEVEL OF GRAPH BY
AIR CONDUCTION.

With the rapidly accumulating audiometric data, the classification of audiograms is an increasingly important subject. It is a particularly vital one in schools for the deaf, where progressive methods of education will inevitably call for

*From the Research Department at the Clarke School for the Deaf.

†Read at the invitation of Dr. Gordon Berry before the American Otological Society at Toronto, May 29, 1935.

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detailed study of the pupil's hearing acuity and his educational placement on such a basis. Several excellent systems for the classification of audiograms in general have been proposed, notably by Guild² and Ciocco³ at Johns Hopkins and by Fletcher⁴, of the Bell Telephone Laboratories. However, in analyzing the graphs presented by pupils in a school for the deaf, one finds a relatively smaller number of types constantly recurring, so that a slightly different system seems applicable to such a group.

We should, therefore, like to present for your study a system of classification of audiograms for use in schools for the deaf. The classification is based on four main divisions, called *classes* and designated by the Roman numerals I, II, III and IV, according to the type of the graph, and on three *subdivisions*, designated by the letters A, B, and C, according to the level of the graph or the amount of residual hearing. The chief characteristics of the four typographical classes, as shown in Chart I, may be described as follows:

Class I characterized by a graph which tends to be horizontal, usually showing a depression in its middle section, with a difference of not more than 40 db. between the lowest and the highest point of the graph.

Class II characterized by a graph composed of two to three segments, the general direction being mainly descending from left to right in the first half of the graph, and mainly horizontal in the second half, the horizontal segment varying not more than 10 db. for the three highest frequencies heard.

Class III characterized by a graph composed of several segments, the general direction being descending from left to right through the first two-thirds of the graph, with a rise at the highest or the two highest frequencies heard.

Class IV characterized by a graph which tends to descend from left to right in a more or less straight line.

The A, B, and C subdivisions have been made on a definite mathematical basis,⁵ so that from the standpoint of amount of residual hearing, the four A, B, and C subdivisions are to a certain extent comparable, Subdivisions A constituting a hard-of-hearing group, Subdivisions B a partially deaf group, and Subdivisions C a profoundly deaf group. However, the importance of differences in character of hearing loss or type of

graph must be constantly borne in mind, the type of hearing loss presented by a pupil in Class IA being quite different from that presented by a pupil in Class IVA, although both may be hard-of-hearing pupils. Classification and analysis of audiograms have been based on the type and the level of the graph of the better ear.

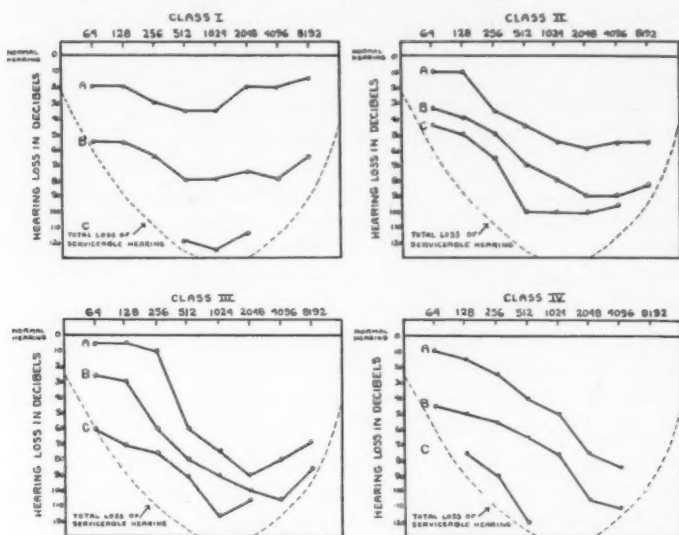


Chart 1. Audiograms characteristic of the four typographical classes and the A, B and C subdivisions.

In Table I, an unselected group of 100 pupils are divided vertically according to the type of the graph, and horizontally according to the level of the graph or the amount of residual hearing.

Subdivisions According to Level of Graph	Classes According to Type of Graph				Total Number of Pupils
	Class I	Class II	Class III	Class IV	
Subdivision A	3	6	5	1	15
Subdivision B	5	7	12	6	30
Subdivision C	3	4	1	47	55
Total number of pupils	11	17	18	54	100

Table I. Distribution of 100 unselected pupils according to type and level of graph.

It is apparent that 11 per cent fall in Class I, 17 per cent in Class II, 18 per cent in Class III, and 54 per cent in Class IV; considering the horizontal subdivisions, 15 per cent fall in Subdivisions A, 30 per cent in Subdivisions B, and 55 per cent in Subdivisions C.

While Class IV is the largest class, and Class IVC, represented by the lowest of the descending curves, is the largest subdivision, it is interesting to note that 46 per cent fall in Classes I, II and III, and that 45 per cent fall in Subdivisions A and B. Classes I, II and III have a wider frequency range than Class IV, many in the first three classes responding to some or all of the speech-sound frequencies (*i.e.*, the range from 400 to 2400 d.v. for vowels and from 1000 to 8000 d.v. for consonants), while the majority in Class IV drop off at 1024 d.v., having no residual hearing for the consonant frequencies, and an extremely small amount of residual hearing in the lower or vowel-sound range. From the standpoint of level of graph and intensity range, the A and B subdivisions constitute a hard-of-hearing and partially deaf group; through bilateral tubes or suitable amplifying devices some, at least, of the speech sounds may be brought to them satisfactorily, and their education can be carried on partially, at least, through normal channels. Since the A and B subdivisions constitute 45 per cent of the total number, the education of a large proportion of deaf children should proceed more and more nearly along normal lines, if otologists do all in their power to keep the hearing loss from progressing and if educators utilize wisely and to the full the residual hearing possessed by these pupils. To bring these progressive changes in the education of the auditorially handicapped, an educational classification along the lines of the A, B and C subdivisions would seem essential, placing with the hard-of hearing group the child deafened after speech and language have been acquired. Goldstein⁶ in this country, Love⁷ in Scotland, and educators in Denmark⁸ and some of the other European countries⁹ have been proceeding along these lines for some years, but the majority of schools for the deaf in this country have no such classification. The co-operation of otologists, educators and research workers is needed toward this end, so that every auditorially handicapped child may have the best possible chance for the most normal speech-language development of which he is capable.

It will be evident as we proceed that the so-called horizontal graphs (Class I) are very far from typical, according to the general understanding of the term; yet it seems wise to make such a division for the occasional typical and the more frequent atypical graph which may fall in such a group. At the present, we are somewhat uncertain whether Class III will always remain an independent division, or whether it will eventually prove to be a variation of Class IV, the more or less straightly descending group. Class III was not discovered until the amplified audiometer was used, the rise at the end and the residual hearing for the higher frequencies being outside the intensity range of the unamplified 2-A audiometer. Deafness is congenital in origin throughout this class, with one exception. It is a true "high frequency" deafness, formerly confused with aphasia, as emphasized in the researches of Ewing^o at Manchester. It would be interesting to determine whether such graphs as we find in Class III are associated with constant and characteristic pathological findings.

HEARING ACUITY BY AIR AND BONE CONDUCTION ACCORDING TO TYPE AND LEVEL OF GRAPH BY AIR CONDUCTION.

In the previous study¹ in this series, we have described in detail the general trend of hearing acuity by air and bone conduction for the entire group of 100 unselected pupils; we have also outlined the method by which mean hearing curves have been obtained and plotted, including the arbitrary scores given to *no response* at maximum intensity on the amplified 2-A audiometer. We will now study the typographical Classes I to IV, the mean curves by air and bone conduction for each class having been obtained by the method described for the entire group.

In Chart 2a, the mean hearing curve by air conduction for Class I tends to remain horizontal (although slightly descending in the first half), and goes through all eight frequencies, the mean hearing loss ranging from 44 to 78 db. The mean bone conduction curve for Class I (see Chart 2b) is nearer normal for the lower tones, but descends abruptly from 256 to 1024 d.v., then remains nearly horizontal through 4096 d.v., and at 8192 d.v. the mean is outside the intensity range of the amplified 2-A audiometer. This would seem to indicate that children who are sufficiently deaf to require special education tend to have a descending bone conduction curve even though

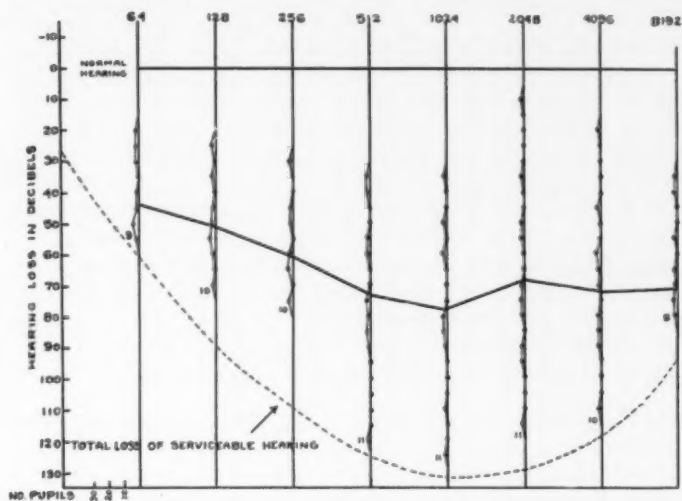


Chart 2a. Mean hearing curve by air conduction for Class I, with frequency distribution at each pitch.

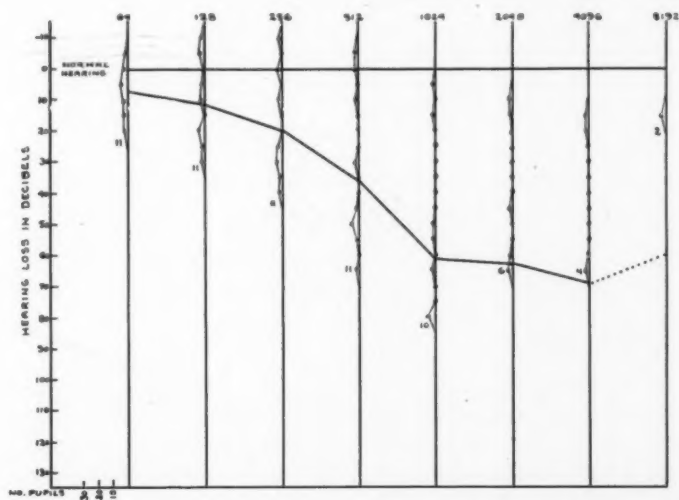


Chart 2b. Mean hearing curve by bone conduction for Class I, with frequency distribution at each pitch.

the air conduction curve remains fairly horizontal. This is particularly true for the B and C subdivisions of Class I, and for these pupils amplification by air conduction should be more useful because of the wider frequency range and the more even loss by air conduction. It should be remembered, as stated in the preceding paper in the series,¹ that the dotted line represents the highest possible arbitrary level. If greater amplification by bone conduction were possible, a larger number of responses might be obtained at the higher frequencies, thus lowering the level of the curve represented by the dotted line. It should also be borne in mind that conclusions regarding the comparative merits of amplification by air and by bone conduction must remain tentative until greater intensity can be used to explore the auditory field by bone conduction.

In Chart 3a, the characteristic mean curve by air conduction for Class II is demonstrated, the first segment descending to 1024 d.v., and the second segment being horizontal, and continuing through 8192 d.v. The mean curve by bone conduction for Class II (see Chart 3b) descends, as in Class I, to 1024 d.v., is horizontal to 2048 d.v., where it drops off. The majority of these pupils theoretically should also receive more help by air conduction amplification because of the wider frequency range and the more even loss by air conduction through the speech-sound range.

In Chart 4a, the mean hearing curve by air conduction for Class III is given. It descends somewhat abruptly to 1024 d.v., gently to 4096 d.v., and then shows a sharp rise to 8192 d.v. The mean bone conduction curve for Class III (see Chart 4b) descends abruptly to 1024 d.v., where it drops off. These pupils should, therefore, be benefited much more by air conduction amplification. By air conduction, Class III have a large amount of residual hearing for fundamental voice tones (90 to 300 d.v.) and a smaller, though usable, amount of residual hearing over the speech-sound range. Here selective amplification is especially needed.

In Chart 5a, the mean hearing curve by air conduction for Class IV is shown as a gently descending curve, dropping off at 2048 d.v. The mean curve by bone conduction for Class IV (see Chart 5b) descends abruptly (and at a slightly lower level than that for Class III) to 1024 d.v., where it drops off. Occasional pupils in the A and B subdivisions in Class IV go

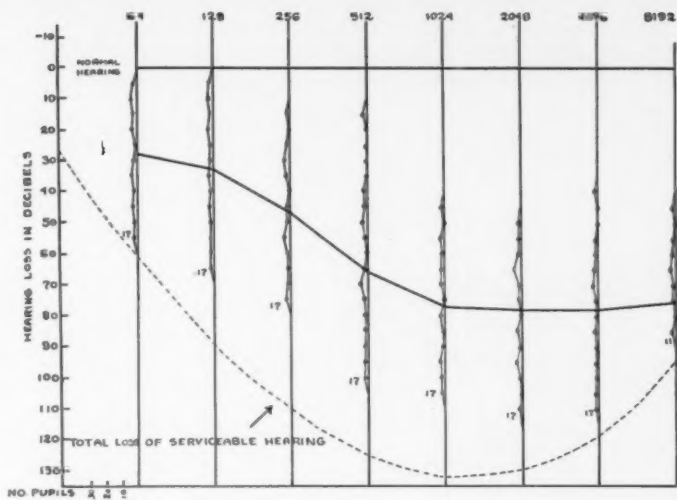


Chart 3a. Mean hearing curve by air conduction for Class II, with frequency distribution at each pitch.

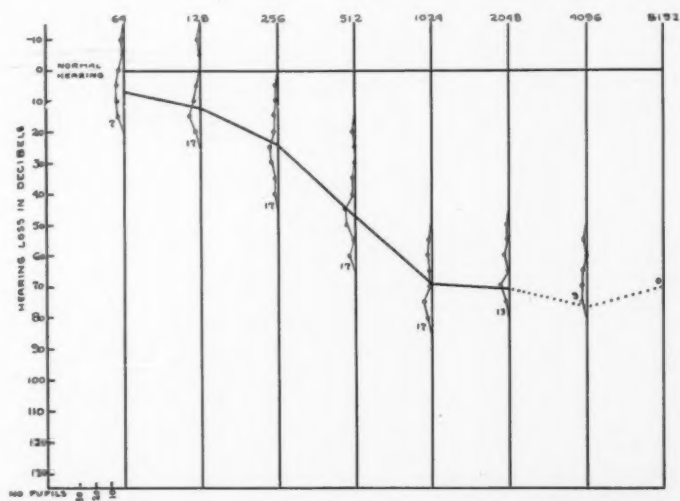


Chart 3b. Mean hearing curve by bone conduction for Class II, with frequency distribution at each pitch.

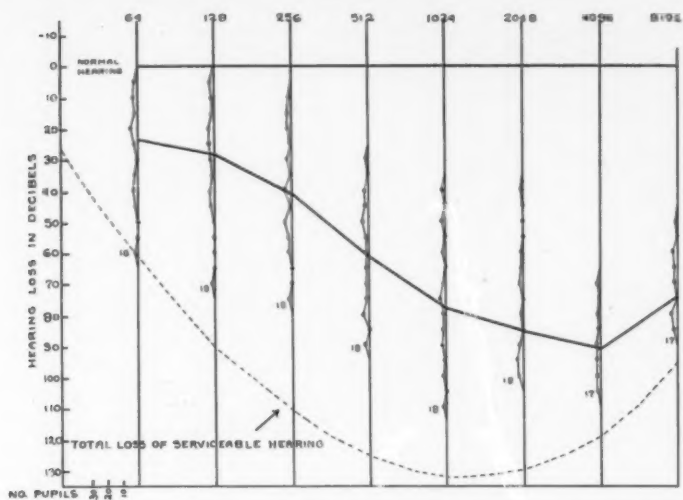


Chart 4a. Mean hearing curve by air conduction for Class III, with frequency distribution at each pitch.

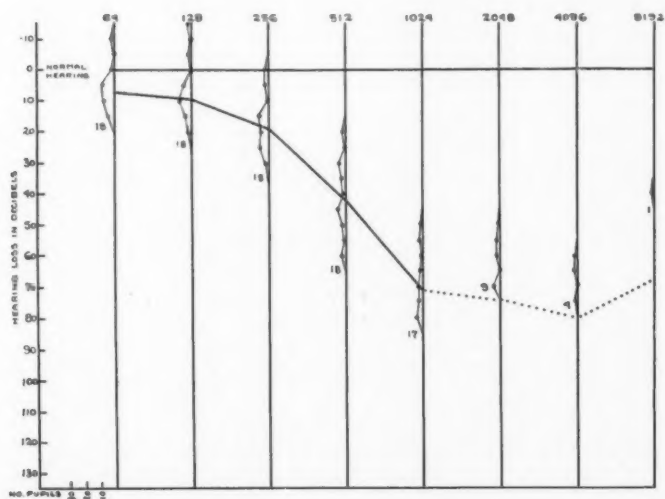


Chart 4b. Mean hearing curve by bone conduction for Class III, with frequency distribution at each pitch.

through the entire eight pitches by air conduction; for them air conduction should hold greater possibilities because of the wider frequency range. But for Class IVC, that is, for the largest subdivision in Class IV, and for some in Class IVB, the frequency range by air conduction is so limited that the higher level of the bone conduction threshold points toward greater help by bone conduction amplification. Few individuals in Class IVC can receive help in actual speech-sound discrimination, but all should be helped in accent, phrasing and inflection.

In general, the hearing loss tends to increase for the higher tones by both air and bone conduction, as one passes from Class I to Class IV, but the number of *no responses* at maximum intensity for the higher pitches increases more rapidly by bone conduction than by air conduction.

The characteristics of the typographical classes and their subdivisions may be further seen in Charts 6 to 8, which give individual illustrative audiograms by air and bone conduction for each of the subdivisions. The relations between air and bone conduction are again apparent. In Subdivision A for each one of the typographical classes (see Chart 6), bone conduction either tends to be normal or is practically superimposed on the air conduction curves; in Subdivision B for each of the classes (see Chart 7), the bone conduction threshold is nearer normal for the lower frequencies, but very little higher for the middle frequencies, and has dropped off entirely for the higher frequencies. In the C subdivisions (see Chart 8), bone conduction is uniformly nearer normal than air conduction, but drops off several octaves sooner.

In general, therefore, as one passes from the A to the C subdivisions in each class, the deviation of the air conduction threshold from normal is increasingly greater than that of the bone conduction threshold from normal. The bone conduction threshold, however, varies sufficiently from class to class and from subdivision to subdivision to make it seem evident that it is not a pure vibratory response. The number of *no responses* at maximum intensity for the higher frequencies again increases more rapidly by bone conduction than by air conduction as one passes from the A to the C subdivisions.

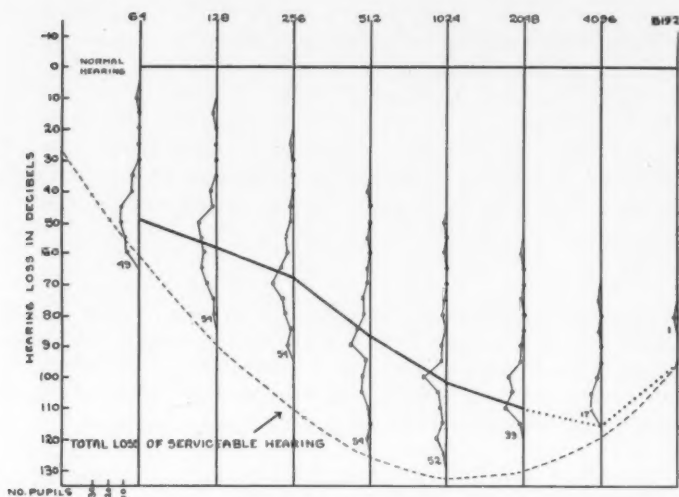


Chart 5a. Mean hearing curve by air conduction for Class IV, with frequency distribution at each pitch.

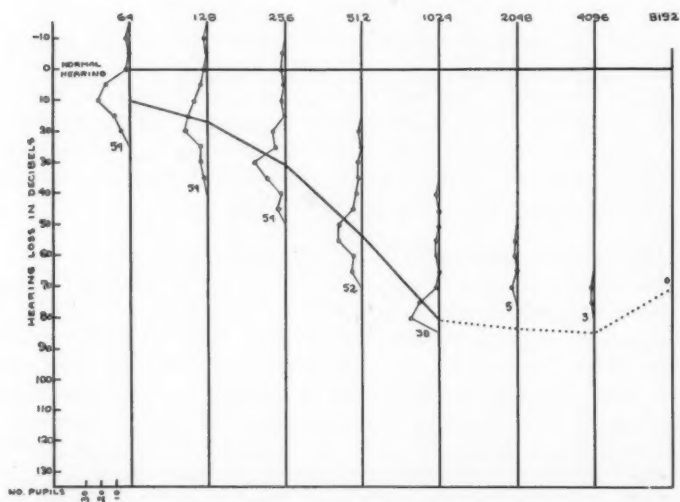


Chart 5b. Mean hearing curve by bone conduction for Class IV, with frequency distribution at each pitch.

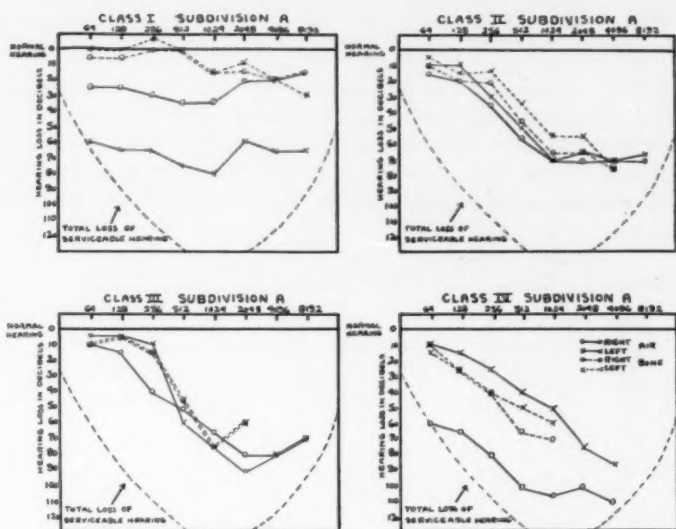


Chart 6. Actual audiograms by air and bone conduction for Subdivision A of Classes I, II, III and IV.

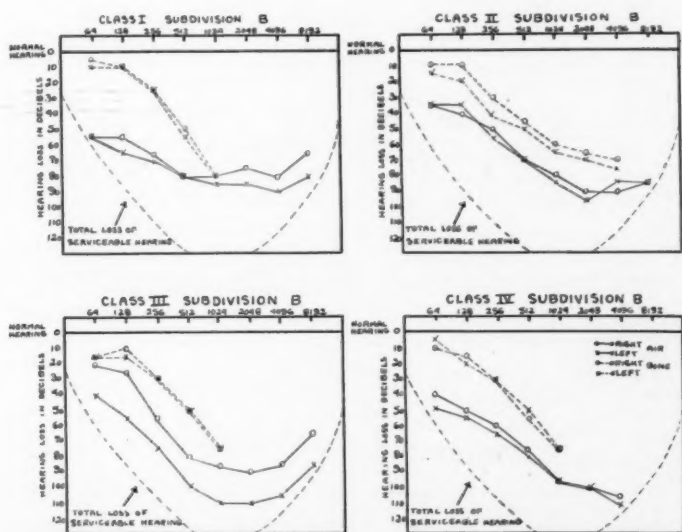


Chart 7. Actual audiograms by air and bone conduction for Subdivision B of Classes I, II, III and IV.

ETIOLOGICAL DISTRIBUTION ACCORDING TO TYPE AND LEVEL OF GRAPH BY AIR CONDUCTION.

The general trend of hearing acuity in the main etiological groups was considered in detail in a previous paper¹ in this series of investigations. We are now concerned with the actual type of graph and amount of residual hearing presented by individuals in these etiological groups. In Table II, the etiologi-

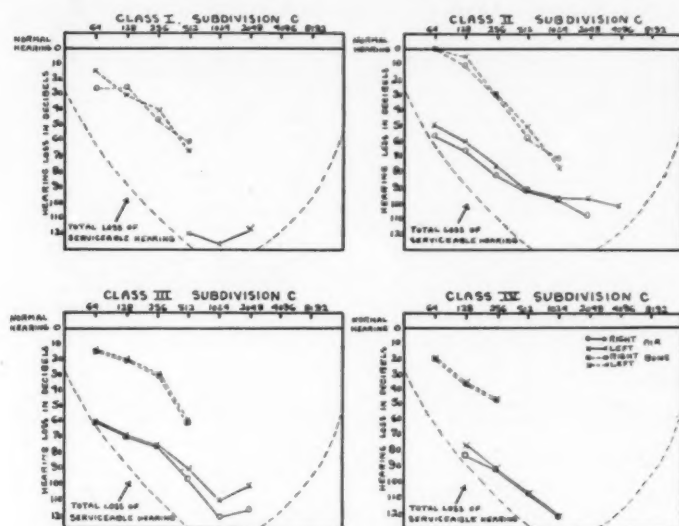


Chart 8. Actual audiograms by air and bone conduction for Subdivision C of Classes I, II, III and IV.

Cause of Deafness	Classes According to Type of Graph				Total Number of Pupils
	Class I	Class II	Class III	Class IV	
Congenital	2	7	11	30	50
Probably congenital	1	3	5	7	16
Cerebrospinal meningitis	1	2		11	14
Disease of ear, nose and throat	6	4		2	12
Toxic neuritis	1	1	2	4	8
Total number of pupils	11	17	18	54	100

Table II. Etiological distribution of 100 pupils according to type of graph.

cal composition of the typographical Classes I, II, III and IV has been tabulated. It is interesting to note that 37 pupils or 56

per cent in the congenital and probably congenital groups fall in Class IV and present typical descending graphs, while 29 pupils or 44 per cent are distributed through Classes I, II and III. It would, therefore, seem evident that congenital deafness does not necessarily imply a typical descending curve. With three exceptions, the meningitis group fall in Class IV, presenting descending graphs. In the ear, nose and throat group 10 pupils or 83 per cent fall in Classes I and II, 2 pupils or 17 per cent fall in Class IV. In the toxic group, 4 pupils or 50 per cent fall in Class IV, 1 pupil in Class I, 1 pupil in Class II, and 2 pupils in Class III.

In Table III, the etiological composition of Subdivisions A, B and C has been tabulated. It will be at once apparent that 29 or 44 per cent of the congenital and probably congenital

Cause of Deafness	Subdivisions According to Level of Graph			Total Number of Pupils
	Sub-divisions A	Sub-divisions B	Sub-divisions C	
Congenital	5	15	30	50
Probably congenital	2	7	7	16
Cerebrospinal meningitis			14	14
Disease of ear, nose and throat	8	2	2	12
Toxic neuritis		6	2	8
Total number of pupils	15	30	55	100

Table III. Etiological distribution of 100 pupils according to level of graph.

groups belong to Subdivisions A and B, meaning that they may be considered hard-of-hearing or partially deaf; while 37 or 56 per cent belong to Subdivisions C and are profoundly deaf. This is quite contrary to some of the earlier conceptions that congenital deafness and profound or total deafness are synonymous. Since deafness is congenital or probably congenital in origin in 66 per cent of the pupils included in this study,* the fact that 44 per cent of this congenital group possess usable amounts of residual hearing is extremely encouraging to all who are working for greater progress in educational methods. The meningitis group belongs uniformly to Subdivision C. Ten or 83 per cent of the ear, nose and throat group are hard-of-hearing or partially deaf, while 2 or

*Recent statistics show that congenital deafness constitutes 60 to 70 per cent of the population of most schools for the deaf. Shambaugh and others (Arch. Otolaryng., 7:415, May, 1928) in the survey of pupils in public schools for the deaf in this country list 60 per cent as congenitally deaf. In 1932, Love (Jour. Laryngol. and Otol., 47:556, Aug., 1932) reported congenital deafness in 72 per cent of the population of the Scottish schools for the deaf.

17 per cent have become profoundly deaf, and fall in Subdivisions C. Six of the toxic group belong to Subdivisions B, and 2 are profoundly deaf and belong to Subdivisions C.

In Table IV, the etiological composition of the A, B, and C subdivisions of each of the four typographical classes has been tabulated. This brings out quite clearly the type and level of the graphs presented by each of the etiological groups.

Cause of Deafness	Class I			Class II			Class III			Class IV			Number of Pupils
	A Subdiv.	B Subdiv.	C Subdiv.	A Subdiv.	B Subdiv.	C Subdiv.	A Subdiv.	B Subdiv.	C Subdiv.	A Subdiv.	B Subdiv.	C Subdiv.	
Congenital		1	1	2	4	1	3	7	1		3	27	50
Probably congenital		1			2	1	2	3			1	6	16
Cerebrospinal meningitis			1			2						11	14
Disease of ear, nose and throat	3	2	1	4						1		1	12
Toxic neuritis		1			1			2			2	2	8
Total number of pupils	3	5	3	6	7	4	5	12	1	1	6	47	100

Table IV. Etiological distribution of 100 pupils according to type and level of graph.

COMMENTS AND SUMMARY.

In the second of a series of auditory function studies, audiometric readings on a group of 100 unselected pupils at the Clarke School for the Deaf have been analyzed according to type and level of graph by air conduction.

A classification is suggested based on: (1) Four classes, designated by Roman numerals, according to type of graph; and (2) three subdivisions, designated by the letters, A, B and C, according to level of graph, Subdivisions A, constituting a hard-of-hearing group, Subdivisions B, a partially deaf group, and Subdivisions C, a profoundly deaf group.

It is proposed that pupils in schools for the deaf be classified along the lines of the A, B and C subdivisions, the results of speech-sound tests* and all other available data on auditory function being taken into account in the decision for educational placement.

*The correlation of individual audiograms to speech sounds heard with and without amplification will be the subject of a later paper.

It is further proposed that the type of the curve, designated by Classes I to IV, serve as a guide in the pitching of the teacher's voice and the type of amplification used for the individual pupil.

Of the unselected group of 100 pupils, 46 per cent fall in Classes I, II and III. Pupils in these classes have a wider frequency range than those in Class IV, many responding to some or all of the speech-sound frequencies (the range from 400 to 8000 d.v.), while the majority in Class IV drop off at 1024 d.v., having little residual hearing over most of the speech-sound range. From the standpoint of level of graph, 45 per cent fall in the A and B subdivisions, and constitute a hard-of-hearing and partially deaf group. This means that the education of a large proportion of deaf children should proceed more and more nearly along normal lines, but to bring these progressive changes in the education of the auditorially handicapped, a classification along the lines of the A, B and C subdivisions would seem essential. Without a classification according to amount of residual hearing, as well as mental achievement, the hard-of-hearing and partially deaf child will be held back by the slower progress of the profoundly deaf child. Moreover, a small hard-of-hearing child placed in a group with profoundly deaf children may develop "attention deafness." These are important aspects of the educational problem which call for the help of otologists and research workers.

Analysis of hearing acuity by air and bone conduction according to class and subdivision shows that: (1) The hearing loss tends to increase for the higher tones by both air and bone conduction, as one passes from Class I to Class IV, but the number of *no responses* at maximum intensity for the higher pitches increases more rapidly by bone conduction than by air conduction; and (2) the deviation of the air conduction threshold from normal is increasingly greater than that of the bone conduction threshold from normal, as one passes from the A to the C subdivisions in each class.

The most striking point in the etiological composition of the classes and the subdivisions is the fact that 44 per cent of the congenital and probably congenital groups are distributed through Classes I, II and III, and that 44 per cent of the congenital and probably congenital groups belong to the A and

B subdivisions, that is to the hard-of-hearing and partially deaf groups. This means that congenital deafness does not necessarily imply a typical descending curve nor does it necessarily mean profound or total deafness, according to some of the earlier conceptions.

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GRADUATE COURSE IN OPHTHALMOLOGY AND OTO-LARYNGOLOGY, DENVER, COLO.

The Summer Postgraduate Course in Ophthalmology and Oto-Laryngology at Denver, Colo., will be held from July 20 to Aug. 1, 1936. The first week's study will be devoted to the eye, and the second week to the ear, nose and throat. The guest speakers will be Dr. Oscar V. Batson, of Philadelphia; Dr. Lawrence T. Post, of St. Louis; Dr. William L. Benedict, of Rochester, Minn.; and Dr. Will Otto Bell, of Seattle. Inquiries regarding the course may be sent to Dr. H. L. Whitaker, 1234 Republic building, Denver, Colo.

NEOPLASM OF THE ANTRUM.*

DR. E. LEO BERGER and DR. MEYER D. BERGER, Brooklyn.

Ewing¹ reported that of 1892 cases of malignant growths only 2.53 per cent were of nasal origin. The exact proportion of antral lesions is not stated, but one can safely assume that it would be a fairly small fragment of this 2.53 per cent. Because of the comparative rarity of these lesions, we felt it incumbent upon ourselves to review the course of each of these three cases, two malignant and one benign in character. In Case 1 we had the opportunity to observe the patient from the initial onset until exitus, thus being able to realize the splendid end-result of co-operative surgical and Roentgen therapy throughout the ailment. In Case 2 we are pleased to state that the patient is still living after three and a half years, again substantiating our faith in the latter mode of therapy. Our third case is included in this series because of the extreme rarity of a mucocele of the antrum and because the diagnostic measures employed are essentially similar to that of the former two patients. One is easily convinced of the extreme importance of thorough investigation in order to determine the type of lesion which is present.

Phillips², in 1898, was the first author to write a very illuminating and comprehensive paper on neoplasm of the antrum.

Holmgren³, who surveyed a series of 59 cases, reported 18.6 per cent cures after a period of three years. These patients were treated by a resection of the superior maxilla by diathermy.

Greene⁴, following a critical study of 84 cases, of which 69 received treatment, advocated surgical removal followed by irradiation. Of 36 patients treated by surgery and irradiation, 33.3 per cent were living from one to five years. Of 33 patients treated by radium alone, only one was completely well two and a half years later.

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Hajek⁵ expressed the belief that radium therapy rather than surgical intervention gives a better end-result regardless of necrosis of the bone. Carcinoma cases responded very readily but were soon followed by recurrence. When employed in inoperable neoplasms of the antrum, radium and Roentgen therapy were totally ineffective.

Asherson⁶ reviewed a series of 40 cases of malignant neoplasms of the nose and antrum and stated that a strong dose of radium can be employed without any ill effects to the external skin, eye, brain or optic nerve. The initial treatment should be of sufficient dosage inasmuch as the response of the tumor to successive doses is very inadequate. He maintained that the bone will not be injured unless there is actual contact of the radium with the bone.

Clevenger and Norris⁷ reported a case of melanoepithelioma which had originated from the mucous membrane of the lower turbinate because they did not find a similar case in the literature.

Rosenwasser⁸ described a case of plasmocytoma of the nasal cavity in view of the extreme rarity of this neoplasm.

Quick⁹ gave a very lucid description of his treatment of neoplasms of the antrum. The difficulty of access to these growths and the inflammatory changes complicate the course of the disease and treatment. He contended that infection is more often the cause of death than the actual growth. (To this belief and experience we cannot subscribe.) The most frequent growth in this area is the adenocarcinoma. In 83 per cent of 136 cases in which treatment was given between 1917 and 1929, the lesion was inoperable. Thirty-nine per cent of these lesions were squamous cell epithelioma, 7.4 per cent adenocystic basal cell epithelioma and 7.4 per cent transitional cell carcinoma. The author believed that carcinoma is frequently mistaken for sarcoma. Only 10 per cent of the lesions were true sarcomas. Of the latter, angiosarcoma, myxosarcoma, fibrosarcoma, and chondrosarcoma were seen. When present, lymphosarcoma is usually part of a general condition. Two of the chief symptoms are obstruction and bleeding. Cervical metastasis, which is present in 73 per cent of the cases, is often the first evidence of the disease. In 59 per cent of the cases of the malignancy of the antrum, prolonged treatment had been given for supposed inflammatory conditions, and in 45

per cent operations had been repeated. Surgical intervention is unsatisfactory in these cases, except in intrinsic carcinoma of the antrum. In order to afford better drainage of the antrum and better approach to the neoplasm, Quick advocates surgical intervention to be followed by irradiation which should be extensive. If the tumor is not completely accessible, radon is implanted in the accessible part of the tumor, and further implantation is done as the tumor shrinks and is removed. For metastasis he used a combination of Roentgen rays, radium and surgical intervention. Short wave Roentgen rays were used if the palpable nodes appeared to be contained in an intact capsule; radium packs were applied, following which dissection and implantation of radon took place. If the capsule was perforated and there was fixation, radium and Roentgen rays were used. Transitional cell carcinoma is radiosensitive and surgical intervention is not indicated. Quick believes that surgical intervention at these sites was only an adjunct to irradiation.

Richter¹⁰ reported 115 cases encountered between 1919 and 1926. Twenty-two of the patients (19 per cent) had been well for five years or more at the time of study. Eighty-five of the tumors were carcinomas and 25 were sarcomas. For operable conditions Richter advised a surgical procedure followed by irradiation, particularly in cases of carcinoma. Sarcoma is more susceptible to treatment by irradiation. For endonasal and antral tumors he employed Denker's premaxillary operation, and he has employed Coutard's irradiation technique.

Hesse¹¹, in a series of 137 patients, employed surgery, or surgery combined with irradiation. Twenty-six endonasal and sinus carcinomas were operated on, and in 80 of these (31 per cent) cures resulted. He, too, claimed good results, both by Denker's operation and by resection of the maxilla combined with irradiation. Sarcoma is more susceptible to irradiation than carcinoma.

Harmer¹² advised close co-operation of surgeon, pathologist, physicist and Roentgenologist in the treatment. For growths in the nose the author found radium preferable, except for radium-resistant tumors, for which he used diathermy. The most common type of tumor found in the sinuses is adenocarcinoma, which has rather a benign course. The best results are

obtained by combined surgical measures, diathermy and irradiation. Harmer advised preliminary treatment by Roentgen rays before biopsy, in order to diminish the possibility of spreading the disease. His expressed preference was for transpalatal approach to tumors of the antrum because of the relatively small deformity that it entails. The gross part of the tumor was removed by diathermy, and then radium was used in heavy doses. He treated sarcoma of the nasal sinuses differently, according to its histologic type. Myeloid or fibrous sarcomas were treated surgically; chondrosarcoma, osteosarcoma, or myxosarcoma by the combined method. Round cell and spindle cell sarcoma he found extremely susceptible to irradiation.

Michel¹³ thoroughly reviewed the literature on tumors of the maxillary sinuses, and concurred in the opinion that these tumors, variously designated as cylindromas, endotheliomas, carcinomas, and sarcomas are frequently mixed tumors of parotid type. He suggested that the tumors of the antrum and ethmoid sinuses, hitherto called cylindromas, have their origin in persistent lateral nasal gland, or Steno's gland, which is found in the lateral nasal wall of the nose of dogs or other mammals, but which disappeared in primates.

Levesque and Gauducheau¹⁴ presented six cases of tumor of the upper jaw and six of tumors of the nasal fossa, including both epitheliomas and sarcomas. At the time of the writing, the 12 patients had survived from one and a half to nine years. The authors found that a combination of surgical measures and radium gave the best results in these cases.

Sharp¹⁵ took up the problem of carcinoma of the maxillary sinus; operation alone has proved unsatisfactory, and it entails a high death rate. Electrocoagulation has been found more satisfactory. At Memorial Hospital, a special technique or irradiation has been developed; operation is employed only to provide exposure and drainage. The technique has been further improved since it has been possible to measure exactly the dosage of irradiation given to the region. Sharp considered the symptoms of the condition. The diagnosis is usually made late, he stated, owing to the lack of subjective symptoms in the early stages of the condition. Secondary infection often masks the pathologic process. Biopsy is the only sure method of making a diagnosis. The author advocated biopsy by means of

aspiration through a needle, according to Martin and Ellis' technique, and suggested that this be used as a routine in all cases of disease of the antrum. According to Ewing, five types of carcinoma are found in the antrum: Adenocarcinoma, Schneiderian carcinoma, squamous cell carcinoma, basal cell carcinoma and transitional cell carcinoma. He stated that he considered infection as playing an important part in the etiology of this disease. Treatment at the Memorial Hospital consists of exposing the tumor through the anterior antral wall and implanting a carefully calculated dose of radon seeds. Three or four days later, the floor of the antrum is removed with the palate and complete exposure and drainage is obtained. At this time, the bulk of the tumor can be removed by cautery and curette. It is inadvisable to repeat irradiation.

Barnes¹⁶ advocated surgical intervention to be followed up by intensive irradiation. Sixteen per cent of his cases in a series of 25 have survived four years.

New¹⁷ has the tumors of the antrum graded according to Broder's method when a biopsy is taken. For low grade neoplasms he employs cautery and diathermy, while for high grade lesions he uses surgery combined with irradiation. He reports a series of 186 cases, of whom 129 had primary antral lesions. Seventy patients had been treated, with 30 per cent surviving the one year period and 22.8 per cent living after three or more years.

Guttman and Beck¹⁸ treated 57 patients by a combination of irradiation and electrothermic operation. In all of the patients that showed no recurrence, the malignant growth was in the anteroinferior portion of the antrum. The prognosis appears to depend on the location of the neoplasm in the antrum, growths lying anterior and inferior to a plane passing through the canthi of the orbit and the angle of the jaw being most favorable. From its biologic characteristics the adult, fully differentiated neoplasm is more amenable to treatment while the anaplastic types are more or less hopeless. The presence of metastases in the neck makes for a gloomy prognosis. The results of therapy, in their series, are not brilliant, but six patients in a series of 69 showing no recurrence. Apparently, in their hands, irradiation combined with an electrothermic procedure has produced much better results than the cold knife or actual cautery as practiced by New.

DIAGNOSIS.

Neoplasm, unfortunately, causes pain in the late stages. This maxim is applicable, too, to growth of the antrum of Highmore. Consequently, a facile diagnosis in this region usually is indicative of a poor prognosis, because the lesion has become extensive. If one is keen enough to make an early diagnosis, the prognosis is invariably good; however, early diagnosis of this lesion is surmounted with infinite difficulty, because it is practically symptomless. When the tumor mass is sufficiently large to cause a sense of fullness and erosion of the bony wall of the antrum with tumefaction of the soft tissues, pain is experienced. Because of the intensity of this symptom the patient seeks advice and relief. The pain is caused by encroachment upon some of the nerve filaments. Frequently an incorrect diagnosis of neuralgia or *tic douloureux* is made. Consequently one must be fully aware of the possibility of neoplasm when confronted by a patient with such an intractable complaint. In the early stages, transillumination, antrum puncture and irrigation, and intranasal examination, will reveal very little. Despite these negative findings, further investigation should be resorted to in order to rule out new growth. Roentgen examination is the most important means available for early diagnosis. X-ray will often distinguish even slight changes in the thickness of the lining mucosa of the antrum. If one is still doubtful of the condition, opaque oils may be employed in order to detect any pathological thickening of the mucous membrane. When a positive finding is made, exploration of the antrum by means of the Caldwell-Luc procedure should be resorted to. Upon opening the sinus through the canine fossa a biopsy specimen can be easily obtained.

DIFFERENTIAL DIAGNOSIS.

In examining a patient who presents himself with facial pain, one must be cognizant of the several ailments which might be a causative factor. Prominent among these are:

Tic douloureux, or trifacial neuralgia, may affect all the three branches of the trigeminal nerve or any one of these: namely, the ophthalmic, maxillary, or mandibular. The pathology of this ailment is unknown. Beginning usually after 35 years of age, *tic douloureux* is characterized by paroxysms

of acute pain in the above distribution, generally of one side only. The intervals between paroxysms vary from seconds to months. The intervals tend to become shorter and the paroxysms more severe and more extensive in their distribution. The attack may be accompanied by cutaneous flushing, photophobia, lacrimation and salivation, as well as by a subjective sensation of swelling in the affected tissues. The attacks are readily initiated by peripheral stimuli, as a breath of wind. In all such cases intrinsic lesions of the antrum must be eliminated by the regular diagnostic procedures.

Maxillary Sinusitis: The symptomatology and diagnosis of this condition are so well known that very little further discussion is necessary. In acute or chronic sinusitis there is rarely any swelling of the overlying tissues unless there has been a perforation of the anterior antral wall into the canine fossa.

Aspergillosis of the Antrum: This infection is rather rare, but a few pertinent facts may not be amiss. Suspicion of aspergillosis should be raised when attacks of sneezing are associated with congestion of the turbinates which do not yield to cocaine. Detection of antral opacity compels one to puncture antrum with unsuccessful irrigation and expulsion of small pieces of greyish-brown, semitranslucent material. This should be examined for mycelium.

Osteomyelitis: In these cases, the patient has a swelling of the soft tissues overlying the affected area, and there is a history of extraction of a tooth or trauma of some sort, with a sudden onset of pain and swelling. Tenderness of the soft tissues is marked. A few days after the onset a brawny cellulitis with or without abscess formation will ensue. The suppuration may perforate through the socket of a tooth or into the nose or canine fossa. The history usually gives an accurate clue to the situation, and, if the process is at all advanced, the X-ray is suggestive.

Acute Dental Abscess: The patient complains of pain in the region of an acutely infected tooth. There may or may not be swelling of the jaw and soft tissues, but usually the signs of acute inflammation are present. The onset is sudden, and the examination of the teeth in the region affected will reveal the cause of the pathological condition. Roentgen examination confirms the diagnosis, but is not necessary as a rule, especially to one trained in dental diagnosis.

Chronic Dental Abscess: In this condition the patient has moderate or no pain in the region affected, and rarely there are swelling and fluctuation. Clinical examination of the teeth will usually suggest the diagnosis without resort to Roentgen examination.

Impacted Teeth: This diagnosis, although obvious, is frequently overlooked. Roentgen examination will facilitate the discovery of the condition.

Radicular Cysts: These are most common between the ages of 20 and 30 years, but may occur at any age. Occasionally they form in connection with the deciduous teeth, but this is uncommon. It is essential that there is death of the pulp with subsequent development of the granuloma. This develops into a cyst because of central degeneration of the granuloma. The pathologic sequence is probably: 1. Death of the pulp; 2. development of a granuloma; 3. irritation of the so-called epithelial rests by bacterial or other toxins, which stimulates them to an overgrowth. This goes on until the lining is epithelialized. They are most frequent in the incisor and cuspid region.

The Roentgenogram is quite conclusive in these cases, together with the finding of a tooth underneath the cyst that has been devitalized either mechanically or by disease. When the cyst has grown to any size it will resemble a dentigerous cyst grossly, there being a uniformly rounded swelling of the jaw without signs of inflammation. There is a history of slow growth and an absence of pain, unless the cyst has grown very large. The tooth, or teeth, in the sockets below the cyst are usually loose. A Roentgenogram will disclose an absence of a tooth in the cyst.

Hard Odontoma: These are slowly growing tumors of dental origin which produce a deformity in the region of the canine fossa. They are extremely hard and immobile and show a sharply circumscribed outline in the X-ray. Their extreme hardness and lack of evidence of metastasis and slow growth, together with the Roentgen findings, will usually give a correct clue.

Adamantinoma: These are slowly growing soft tumors producing deformity without signs of inflammation. They do

not metastasize. X-ray may give a suggestion as to the disease, but biopsy alone will make the diagnosis conclusive.

Foreign Body of the Antrum: Metal drainage tubes, broken instruments, and bullets, are the usual offenders. X-ray is the telltale diagnostic measure.

Tuberculosis: This condition is too rare to be considered seriously.

Syphilis: Luetic necrosis may affect the walls of the nose, invading the superior maxilla and leading to exfoliation of large pieces of osseous tissue. The cardinal sign of this condition is necrosis of bone.

TREATMENT.

When a neoplasm is exposed by means of a Caldwell-Luc, as much of the growth as possible should be removed by an endothermy knife. The buccogingival orifice should be maintained patent for the purpose of implanting radon seeds, if necessary, and of observing the progress of the lesion. Immediate irradiation by Coutard's method should be employed if the tumor is radiosensitive. If the lesion is radioresistant, radical resection of the superior maxilla should be performed. One must be on the alert for possible metastases. If the latter occurs, immediate irradiation should be employed. The most satisfactory results in tumors of the antrum are accomplished by combined surgical measures, diathermy and irradiation, as so ably described by Harmer.

CASE REPORTS.

Case 1: Patient, R. K., age 60 years, was admitted to the Jewish Hospital on May 15, 1932, with the chief complaint of swelling and pain below the left ear. Personal history was essentially negative. Family history was irrelevant. About three months previous to admission into the hospital, the patient began to experience pain below the left ear, in which region she was also conscious of a swelling. The mass gradually increased in size and the pain became more intense.

About two months ago she had endured moderate epistaxis, principally from the left nares. Besides these complaints she had been suffering with marked nasal occlusion of the left side from which she has had a profuse purulent discharge.

Furthermore, she proclaimed that the left cheek had been exceedingly sensitive to the slightest palpation.

Throughout this ailment, she had noted an increasing asthenia associated with a slight loss of weight. In reviewing her various other symptoms nothing remarkable was complained of by the patient, except for slight nausea.

Physical examination revealed a white female, about 60 years of age, not acutely ill, well oriented. There was a definite asymmetry with some swelling of the left cheek and along the left ala nasi, and a slight narrowing of the left palpebral fissure. There was no erythema over this area. Patient appeared to be a mouth breather because of nasal obstruction. Eyes were negative, except for the above findings. A large globular mass occluded the left nares and filled the entire vestibule. The origin of the growth could not be determined then because of complete obstruction; however, a purulent discharge was noted here. The left antrum was definitely tender to pressure. Transillumination revealed a dark left antrum. Posterior rhinoscopy was negative. The buccogingival recess on the left side was obliterated by a protruding globular mass which was firm in consistency. Ears revealed nothing unusual. Hard nodular glands filled the left submaxillary triangle and posterior triangle above. These glands were the size of walnuts, fixed and slightly tender to palpation. There was no tracheal tug or fixation. Rest of examination revealed nothing of import. Our impression was that of a neoplasm of the antrum invading the nose with cervical metastases.

X-ray showed the left antrum to be markedly opaque, with definite destruction of the superior maxilla. The floor as well as the roof of the antrum were involved. The process extended apparently into the nose, suggesting an advanced neoplastic process. X-ray of both lung fields revealed no pathology. The heart was normal in configuration. Urine was negative. Blood count was normal. Blood pressure was 150/84.

The patient was operated upon on May 24, 1932, nine days following admission, by Dr. E. Leo Berger, who performed a Caldwell-Luc procedure with an endothermy knife. The antrum was opened in the usual manner and a hard globular growth which arose from the medial antral wall protruded into the sinus. Both this wall and the bony structure of the canine fossa were destroyed by the neoplasm which bathed in a foul-

smelling necrotic exudate. The mass was exenterated from the lateral nasal wall and the floor of the antrum was denuded of its mucous membrane. The sinus and nose were packed with iodoform gauze. The postoperative course of the patient was uneventful.

Pathological Report: Macroscopic: Red pieces of tissue. Piece of skin which was thickened and subcutaneous tissue. Small pieces of yellow soft tissue. *Microscopic:* Examination of all the specimens showed a malignant process characterized by the presence of, for the most part, irregular spindle and polyhedral cells with hyperchromatic nuclei. In some, other specimens, especially those from the so-called polyps, there were a number of very large cells with one or more nuclei. Some specimens showed a very fine reticulum separating the cells from one another. Many of the lymphatics contained large collections of malignant cells. The growth was the seat of chronic inflammatory process with invasion by a few polynuclears, round and plasma cells. *Diagnosis:* Mixed cell sarcoma.

X-ray of the antrum, eighteen days postoperatively, revealed the following: The outer left nasal wall had been removed surgically. There was a slight homogeneous opacity in this region, which was probably due to neoplastic or inflammatory reaction secondary to surgical intervention. The antrum, which was formerly decidedly clouded, was clearer than before. No osteonecrosis was observed.

The patient was discharged from the hospital on June 14, 1932, one month following admission.

Since then, she was given 11 sets of Roentgen therapy until her second admission into the hospital. Three positions were employed: 1. Directed over anterior surface of the antrum, canine fossa; 2. directed over lateral surface of the antrum; 3. directed at antrum from below through submaxillary area. Cross fire radiation with a dosage of 70 per cent of skin erythema was used from a distance of 37.5 cm. through a filtration of $\frac{1}{2}$ mm. copper and $\frac{1}{2}$ mm. aluminum. The field was 8 by 10 cm.

She responded splendidly with the disappearance of the cervical adenopathy and the return of the normal contour of the left cheek. She persistently complained of extreme dryness

of the tongue and buccal mucous membrane. The condition was undoubtedly attributable to the deleterious effect of the Roentgen rays upon the salivary glands.

The buccal opening into the antrum was maintained patent, in order to detect any possible recurrence. Through this opening the sinus was irrigated to remove the slight amount of detritus as a result of eating. Upon the examination of the patient, one could readily note the normal mucous membrane which lined the antrum and the large window into the nose from which the entire inferior turbinate was removed. The cleft in the mouth was closed by a denture which prevented food from accumulating.

On Jan. 1, 1934, the patient was admitted into the hospital irrational and delirious, requiring restraint. P. X. revealed several small confluent lymph nodes palpable under the left ramus of the mandible. One gland was felt in the right anterior triangle which node was neither hard nor fixed. The impression was possible intracerebral metastasis or uremia. On Jan. 2 patient developed meningeal signs, the cause of which could not be determined. Spinal fluid and blood chemistry were negative. Medical consultant diagnosed the condition as bacteremia and suggested a blood culture, which was negative. On Jan. 7 patient died.

Postmortem: General: The body is that of a fairly well developed and well nourished white female, 61 years of age. External body examination reveals no significant findings. The superficial lymph nodes are not enlarged.

A thorough postmortem examination of Case 1 (by Dr. M. Lederer) failed to reveal any evidence of the sarcoma in the antrum or metastases throughout the body.

Case 2: Patient, S. G., was admitted to the Jewish Hospital March 11, 1932, with swelling in the region of the left antrum, two years in duration. He had difficulty in breathing through the left nostril for the past six months. Six years ago patient was troubled with excessive lacrimation from the left eye on two occasions. The left lacrimal duct was opened. This lacrimation persisted until a few months ago. About two years ago, friends of the patient noticed a swelling of the left cheek, which prominence had been slowly increasing in size. This swelling has never been painful nor has it interfered with

patient's mastication or vision. About six months ago, however, he, for the first time, noticed that he was unable to breathe through the left nostril. This obstruction has persisted to date.

Physical Examination: Negative, except for hard, irregular swelling apparently arising from the left antrum and encroaching upon the left nares and, to a slight extent, upon the left orbit. The swelling was stony hard, non-fluctuating nor cystic, and was not tender. Teeth were missing, including 3456. Edentulous mucosa was distended over the premolar region and at the mucobuccal fold. The impression was a tumor of the antrum.

X-ray of the Skull: There was a dense opacity in the region of the left maxillary sinus suggestive of tumefaction. Chest X-ray revealed a slight generalized haze, probably due to a healed tubercular infection. Blood Wassermann and Kahn were negative. Blood chemistry was normal. Bence Jones was not found in the urine, which was negative. Blood count was normal. He was discharged March 19 to be observed by Dr. M. Wasch.

On May 18 he was re-admitted for biopsy study. A Caldwell-Luc was performed by Dr. E. Leo Berger. The entire anterior wall of the maxillary antrum was removed. A soft mass involving the entire anterior and medial antral walls was removed. Very little sanguination was noted. The antrum was packed with iodoform.

Pathological Report: Few pieces of soft pink tissue and fragments of bone. *Microscopic:* Consists of connective tissue stroma, scattered throughout which are numerous islands of malignant cells which seem to be of endothelial origin. In some places there is a resemblance to papillary formation. *Diagnosis:* Carcinoma.

The patient made an uneventful recovery and was discharged June 1. He was given several sets of Roentgen therapy by Dr. M. Wasch, analogous to Case 1, throughout the next year and was constantly under our observation.

On Apr. 4, 1934, the patient was admitted into the Jewish Hospital because the tumor mass residual had not regressed completely with Roentgen therapy. On Apr. 5 the left superior maxilla was resected *in toto* according to Diffenbach's method, under avertin anesthesia. The old Caldwell-Luc scar was

adherent to the anterior maxillary surface. The cheek was dissected away, removing some infiltrated carcinomatous tissue from it at the same time. The entire internal, external wall to the malar bone, orbital plate and posterior walls were removed with both the inferior and middle turbinates intact. The large tumefaction was included in this mass. The floor of the superior maxilla was left. This area was packed with iodoform drain. The skin was sutured with black silk.

Pathological Report: Numerous fragments of soft granular red tissue accompanied by one molar tooth. *Microscopic:* Consists of numerous papillary structures with a central core of fibrous connective tissue lined by high columnar cells. These cells show all signs of malignancy. *Diagnosis:* Papillary adenocarcinoma.

The next day the temperature rose to 102° during the night. The patient received intravenous glucose and continuous Murphy drip. He began to take fluids by mouth and felt fairly comfortable. The following day the wound was dressed and appeared to be healing well. Eight days postoperative, temperature was flat and patient was out of bed, apparently very comfortable. External wound healed well. There was a localized abscess on the left upper palate, which was incised and cleared in a few days. Left facial paralysis was definite. He was discharged on Apr. 17 in splendid condition. Since his discharge, patient has been examined on several occasions and has revealed no evidence of recurrence.

Case 3: Patient, J. M., was admitted into the Jewish Hospital on Jan. 15, 1934, with a chief complaint of discomfort, pain and swelling of the left eye for the past six months. The swelling has become pronounced during the last two weeks. For the past six months he experienced discomfort in his left eye. He visited an optician, who advised glasses. Occasional pain was endured in this area, but at no time was it incapacitating. The sight in this eye has not been impaired. Two weeks ago the upper and lower lids, principally the latter, became swollen.

P. X. negative, except for nasal and eye findings. The left eye was proptosed moderately without any fixation or chemosis. The fundi were negative. The left eyeball higher horizontally than the right gave one the impression of ptosis of the left upper lid. Upon inspecting the nose, one noticed a bullous

congested mass filling the left middle meatus. No purulent discharge was seen. The impression was a benign tumor of the antrum which encroached upon the orbit and the ethmoid regions.

The left antrum was pitch black to transillumination. Upon puncture a profuse brownish gelatinous fluid was obtained. Immediately thereafter, the left eyeball receded and became lower, with much relief on the part of the patient. Lipiodol was then injected into the antrum and revealed a cystic mass which had eroded the floor of the orbit and ethmoid region. The symptomatic relief of the patient following puncture was consequently self-explanatory.

A Caldwell-Luc procedure was performed. Upon opening the antrum a bifid sinus was found with a small anterior partition which was normal in appearance. A bony septum was removed with much gelatinous brownish fluid being expressed. A large cystic mass was found in the posterior part of the antrum. This cyst had eroded the orbital plate and the nasal plate which was very thin. The cyst communicated with the ethmoid region. The lining wall of the cystic cavity was removed and the antrum was packed with iodoform. The patient made an uneventful recovery and was discharged on Jan. 20. Since then he has been totally free of any complaints.

Pathological Report: Consists of numerous pieces of thin transparent tissue and few pieces of bone. *Microscopic:* Consists of papillary structure lined with columnar cells, some goblet cells. No evidence of malignancy.

SUMMARY.

The above three case reports reveal the urgent need for precise diagnostic investigation of tumor lesions of the antrum of Highmore. Following a diagnosis, intelligent co-operative therapeutic measures of both the surgeon and Roentgenologist offer the most satisfactory end result in this phase of the neoplastic problem.

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887 Ocean Avenue, New York.

COURSE IN OTO-RHINO-LARYNGOLOGY.

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This instrument is manufactured by the Storz Instrument Co., of St. Louis, whose advertisement appears on page 3 of this issue.

520 Frisco Building.

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IN MEMORIAM

ALBERT ALEXANDER GRAY, M.D., F.R.F.P.S.

1869-1936.

We regret to chronicle the passing of Dr. Albert A. Gray, of London, one of the outstanding masters of modern otology of the past three decades.

Born in Glasgow in 1869, he received his early education there, obtaining his degrees of M.B., C.M. in 1890, and M.D. in 1896, all with honorable mention, at Glasgow University.

His early otolaryngologic training was received in Munich and in 1898 he began the practice of his specialty in Glasgow. In 1900, in collaboration with J. G. McKendrick, he wrote chapters on the ear and vocal sounds for Schafer's textbook on Physiology.

His inclinations for research and his training in physics, comparative anatomy and physiology, added to his otolaryngologic specialty, qualified him to a high degree for the valuable contributions that he has made to science. Much of his time was spent in the anatomical laboratories and study of preparations of the ear, especially of the labyrinth.

In 1907-08 he published in two volumes "The Labyrinth of Animals," an authoritative and far-reaching volume with stereoscopic labyrinth pictures of great beauty, careful measurement, accurate description and extensive analysis in this but little known field.

In 1910 appeared his book, "The Ear and Its Diseases," a volume which appealed alike to student and otologist for its clarity and comprehensive presentation.

For 25 years he made a serious study of the perplexing problems of otosclerosis, both in the laboratory and in the clinic, and in 1917 published his monograph, "Otosclerosis," and, as he termed it at that time, "idiopathic degenerative deafness." He stressed the pathogenesis and the biological

significance of otosclerosis rather than the symptomatology and diagnosis. His scientific labors and observations and suggestions for improved laboratory technique were always accomplished individually and independently. He was an original thinker and worker and had the capacity of a genius in the development of detail.



In 1924 he published the first volume of his monumental "Atlas of Otology," illustrating the normal and pathological anatomy of the temporal bone; the second volume followed in 1933.

To the discerning reader this "Atlas of Otology" indicated the unusual talent, versatility, experience and intimate knowledge of his subject and readily stamped this work as one of the outstanding contributions to otologic literature.

These splendid and original contributions won the admiration and recognition of his professional colleagues. In 1909 he was awarded the Lenval prize in Otology at the International Otological Congress in Budapest; in 1911 he received the gold medal of the American Academy of Ophthalmology and Otolaryngology; in 1929 the University of Groningen gave him the Guyot Quadrennial Prize, and in 1933 he received the Dalby Memorial Award.

He was further honored by his colleagues with the presidency of the Section of Otology of the Royal Society of Medicine, 1914-1916; president of the Section of Otology of the British Medical Association, in Glasgow, in 1922; president of the Collegium Oto-Rhino-Laryngologicum, at the London meeting in 1929.

For the past 25 years Dr. Gray was a loyal and valiant collaborator on the editorial staff of *THE LARYNGOSCOPE*, and his advice and judgment in helping to shape the policies of this journal and his occasional and important contributions were deeply appreciated.

In 1898 he was married to Miss Mabel Henderson, of Glasgow. He is survived by two sons: the elder is headmaster of Bootham School, York; the younger is a doctor in Haslemere, Surrey.

After the death of Mrs. Gray, in 1927, he resigned his university and hospital positions and private practice in Glasgow and went to London. Here he continued his research work in several hospitals for the aged, concerning himself especially with his favorite problem, the study of the pathogenesis and pathology of otosclerosis. Several years ago he was given a grant at Ferens Institute, Middlesex Hospital, London, to continue these investigations.

In August, 1935, I had my last visit with this much esteemed colleague, whose friendship during the past 30 years will always be a bright spot in my memory. In his small laboratory at Ferens Institute he was intensely engaged in his most recent research, a specialized therapy in otosclerosis.

Last May Dr. Gray presented to the Section on Otology of the Royal Society of Medicine his "Treatment of Otosclerosis and Similar Types of Deafness by the Local Application of Thyroxine." During my visit to Ferens Institute I had the privilege of seeing him apply this new technique and therapy in a group of cases; he was very hopeful of the results and in his preliminary report tabulated about 50 per cent of his cases as improved in hearing and about the same number with reduction or cessation of tinnitus. This report was published in the October, 1935, issues of *The Journal of Laryngology and Otology* and *THE LARYNGOSCOPE*.

The consensus of opinion, as expressed by some of the seniors in otology, on Dr. Gray's presentation was that if it had been offered by a colleague less experienced in the intricacies of otosclerosis and less conservative than Gray, the favorable reports of hearing improvement and tinnitus reduction might have been more dubiously accepted.

The distinction which Albert Gray attained, and the recognition and honors conferred upon him by the profession, had no tendency to change the modesty, simplicity and gentleness of his character. He was an enthusiast in science and natural history, an inspired reader of Shakespeare, an active participant in all new thought in science, a consistent attendant at medical meetings, a loyal friend, and a sincere man. His name has always been respected in medical circles and his contributions will go down in history as among the most important in the field of otology.

M.A.G.

THE NEW YORK ACADEMY OF MEDICINE.

SECTION OF OTO-LARYNGOLOGY.

Meeting of Oct. 16, 1935.

DR. WESTLEY M. HUNT: The Section of Oto-Laryngology is particularly privileged tonight to join with the New York Roentgen Society in presenting to you the program of the evening. I am going to ask Dr. Spillman, the president of the New York Roentgen Society, to introduce the speaker of the evening, Dr. Henri Coutard.

DR. RAMSAY SPILLMAN: In 1931 at Atlantic City the American Roentgen Ray Society had as its guests two distinguished radiation therapists, Dr. Henri Coutard, of France, and Dr. Elis Berven, of Sweden. In his communication at that time Dr. Coutard stressed the importance of repeated examinations of the patients, the rationale being that in many cases treatment was undertaken on lesions so extensive that only as the disease regressed could the point of origin of the lesion be determined. In this connection a remark of Dr. Berven's will bear repetition: "The results that Coutard has obtained, I think depend upon himself. He follows his patients very carefully. He examines his patients at least twice a day. He follows their general condition and he knows what injury he causes and he knows what reactions come from the treatment."

"The indications for the treatment, as well as the carrying out of this treatment, are yet so complicated that we cannot look upon Coutard's method as a method for use in general Roentgen practice, but the further development of this method, as well as the development of the radium method, must be carried out at the large special clinics."

It is well known that the Coutard method of treatment is formidable. There is the deliberate production of so marked a cutaneous reaction that in the discussion in 1931 Dr. George E. Pfahler said that its routine use in this country would lead us into many law suits for X-ray burns. Yet desperate conditions call for desperate measures. Dr. Coutard stated in 1931 that at the Curie Institute, epitheliomas of the tonsillar region of limited extension are treated preferably by radium therapy. Therefore when he speaks, in his 1931 figures, of three-year cures of 12 out of 46 cases of cancer of the tonsillar region, he has salvaged 26 per cent of patients whose lesions were not only utterly beyond hope from surgery, but extending, in more than half the cases, to the palate, the uvula, and often the glossopharyngeal folds, or even further. For cancer of the hypopharynx, 13 out of 89, or 14 per cent, had three-year cures. For cancers of the larynx, 25 out of 77, or 32 per cent, were equally favorable. Pending the chemical agent, biochemical or otherwise, that will have a selective lethal action on tumor cells when injected into the blood stream, these are results which invoke our profound admiration. Dr. Coutard, please accept this joint meeting tonight as a tribute to a success which obviously is founded on a combination of distinguished scientific ability and a high order of moral courage. It is our pleasure and privilege this evening to hear what the intervening four years have added to the experience from which you spoke in 1931.

Roentgen Therapy of Epitheliomas of the Tonsillar Region, Hypopharynx and Larynx. (An Extension of Observations Reported Before the American Roentgen Ray Society in 1931.) Dr. Henri Coutard.

(To be published in a subsequent issue of THE LARYNGOSCOPE.)

DISCUSSION.

DR. MAURICE LENZ: In view of the universally enthusiastic reception of the Coutard method of X-ray therapy at present, it might be interesting to recall a statement by Pancoast, one of our leading radiologists, made at the June, 1934, meeting in Chicago of the American Radium Society, when he said: "After adequate trial over a period of many years we have found the results of radiation treatment of laryngeal carcinoma to be very disappointing, though it may be of use as a palliative and possibly as a postoperative measure." Dr. Regaud, of the Radium Institute of Paris, who was present at the meeting, opened the discussion by a report of 12 cases of laryngeal cancer, eight of which were clinically arrested by X-ray therapy alone. This announcement, however, apparently did not make much of an impression as four years later, Gabriel Tucker, an outstanding laryngologist, of Philadelphia, was still able to summarize American Laryngologic opinion as follows: "It is generally conceded that X-rays and radium have no place in the treatment of cancer of the larynx except postoperatively." Even as recently as 1930, our own late Dr. Coakley was opposed to X-ray therapy for cancer of the larynx, although he completely reversed this position in 1931 and thereafter was a most enthusiastic supporter of this treatment.

This pessimistic attitude prevalent among radiologists and laryngologists was justified for two reasons: Firstly, due to insufficient dosage, only palliative results were being obtained; secondly, when larger amounts were administered they were given in such a short space of time that the surrounding normal tissues were irreparably damaged, and the treatment was frequently followed by late necrosis of the laryngeal cartilage with consequent aspiration, pneumonia and death.

The speaker of this evening overcame both of these obstacles and evolved a method of X-ray treatment which permits the administration of maximal doses to the cancer with minimal injury to the surrounding normal tissues. Under the stimulus of Regaud, who demonstrated the superiority of protracted radiotherapy on Rams' testes, Coutard began giving maximal doses tolerated by the normal tissues, divided into smaller daily fractions, completing his entire treatment within several weeks. The total dose was so much larger than those given previously within the same space of time that, while the surrounding tissues recovered quickly after this first series, the treatment was practically never repeated, except in very unusual instances. The clinical results improved immediately and when published led most radiotherapists to substitute the Coutard method of X-ray therapy for other techniques whenever permanent arrest was attempted in the treatment of epitheliomas of the pharynx and larynx. However, not only in malignancies of the pharynx and larynx, but in cancers of many other locations, has the Coutard method changed the position of X-ray therapy from a palliative to a curative procedure.

Dr. Coutard's presentation tonight serves to emphasize the fact that radiotherapy of cancer presupposes more than the mere possession of modern X-ray equipment and technical information. It requires familiarity with the disease and the ability to evaluate clinical signs and symptoms. On the basis of clinical observations of the anatomic location of metastatic lymph nodes in the neck, Coutard has plotted a scale of radiocurability and has been able to trace hidden primary lesions in the pharynx and larynx. This diagrammatic division of the neck will be especially appreciated by those who, when confronted with enlarged lymph nodes in the neck, have only too frequently sought in vain for an explanation in the pharynx or larynx.

The observations on the periodic variation of radiosensitivity are extremely interesting and may prove to be very valuable. However, due to the numerous known and unknown factors which also influence this quality, the problem is as yet so complicated that we are far from a solution. As stated by the speaker, undifferentiated and non-infiltrating epitheliomas have responded to all different techniques given in various periods while well differentiated and infiltrating types have frequently resisted all types of treatment. We all hope that this newer conception of periodicity will help in these epitheliomas.

As the originator of the method, Coutard naturally has the oldest results. As expected, these were poorest in hypopharyngeal cases, on account of the nonaccessible intrathoracic lymph node metastases and were better in epitheliomas of the tonsil and larynx, the metastases from which may be more readily included within the field of irradiation.

He mentioned the importance of radiographic examination for determining the extent of hypopharyngeal epitheliomas and the occurrence of late metastases in these cases. We presented such a case before you about two years ago. Up to the present, this patient has not shown clinical evidence of either local reappearance or distant metastases. It is, however, only three and a half years since her treatment, and some of Coutard's cases did not show clinically recognizable metastases until seven and eight years!

This discussion would be incomplete without a few words as to the modifications of Coutard's technique for the purpose of reducing the time necessary for the daily treatment. On account of their recent origin, these methods can not as yet be properly evaluated, as statistics based on observations which are less than five years are often misleading. For instance, at the recent meeting of the American Congress of Radiology, Dr. Coakley and Dr. Stout and I reported 11 early clinical arrests in 24 cases of tonsillar and laryngeal epitheliomas treated by X-ray therapy with 10 r. instead of the usual 4 r. per minute. Of the 11 originally reported as arrested, only six are still free from clinical evidence of cancer three to four years after treatment. Thus, instead of the 46 per cent clinical arrests originally reported, in reality we obtained only 25 per cent. It is also possible that there will be further shrinkage of this number in the next two years.

In 1928, when we first proposed the use of 30 MA. in the Coutard treatment, the importance of total duration of the treatment, the size of the field and the daily dose had not as yet been fully appreciated. As much as 500 r/o daily, over fields 12x15 cm., were frequently administered and the treatment was completed in 12 to 15 days. A few cases were arrested but they later developed radiation changes in the surrounding normal tissues. One of these cases I demonstrated before you not quite two years ago. He has since died from pneumonia, four and three-fourths years after treatment, free from cancer but with marked changes in the irradiated tissues. Nowadays, when the treatment is given over a longer period, preferably with smaller fields, and the daily dose does not exceed 300 to 350 r., we do not see these injuries, although we persist in using 10 r. instead of the orthodox 4 r. per minute. Dr. Martin and Dr. Herendeen at the Memorial Hospital have been using 60 r. per minute. Their total doses are higher than Coutard's but their fields are so much smaller that for the treatment of metastases they usually rely on separate small fields for X-ray therapy or use interstitial radium. Whether their final results will be as good as those of Coutard with his larger fields will be seen in the future, but certainly the economy of time of treatment per patient can not be disregarded.

As the injuries to the normal tissues do not vary appreciably if one uses 4 or 10 r. per minute and as the gross three-year results in undifferentiated epitheliomas are about the same, the opponents of the more rapid administration of daily dosage will have to demonstrate the superiority of the slower method by quoting better five-year results in well differentiated epitheliomas.

Whether the original Coutard method or some modification will finally prove to be more advantageous, Coutard deserves the credit for having developed a technique which permits the administration of cancericidal X-ray therapy without undue injury to the surrounding normal tissues.

I appreciate the honor of being permitted to open the discussion on one of the most informative presentations to which it has been my privilege to listen and wish to thank Dr. Coutard for his excellent paper.

DR. WILLIAM HARRIS: Again it has been our honor and privilege to greet Dr. Henri Coutard. His paper marks another milestone in the advancement

of our knowledge in the diagnosis and treatment of neoplasms in the upper respiratory tract.

The previous discussor mentioned the fact that Pancoast and Tucker considered Roentgen therapy of no value in the treatment of primary carcinomas of the larynx. That opinion was shared by most of the radiologists in this country up to 1930. At that time the production of a brisk erythema, not to mention vesiculation of the skin, brought consternation in most clinics. It may even be added that at the time of Dr. Coutard's first presentation in this country at the annual meeting of the American Roentgen Ray Society in 1931, considerable doubt was expressed regarding the safety of the Roentgen doses such as he suggested. However, that is past history, for we are now convinced that his teachings were correct.

Coutard's first and basic principle is that the treatment of a cancer patient must be a clinical one. Constant clinical observation of the patient and daily investigation of the response of the neoplasm to treatment is the guide for the manner in which the patient should be treated rather than any fixed or stereotyped method of treatment. The second basic principle is the use of daily protracted fractionated doses of Roentgen therapy whereby from five to 10 erythema doses may be given to any portal if its size is not too large.

Treatment of this kind is accompanied by rhythmic destruction of the mucous membrane (radioepithelitis) and subsequent destruction of the epidermis (radio-dermatitis) which heals completely after several weeks. It is by the use of this principle that a sufficient depth dose can be administered to certain neoplasms for their complete destruction.

In our experience at the Mt. Sinai Hospital we have been able to carry out the principles as suggested by Dr. Coutard and the response to treatment followed closely his reports and those of other clinics. It is generally accepted that 25 per cent of the lesions occurring in the extrinsic and intrinsic larynx may be made symptom free for a period of three to five years if one carries out the principles laid down by Coutard. In our experience radiosensitivity depends more upon the exact anatomical location and the question of infiltration of muscle and cartilage rather than upon the histological configuration and grade of the microscopic specimen. The so-called radioresistant group comprises 75 per cent of the material. In order to improve our results with this group of cases, some modification of the technique used hitherto must be made. Dr. Coutard's suggestion of greater protraction and change in the periodicity of the treatment may prove to be the answer. Personal experience with greater protraction is too recent to warrant comment.

From a practical standpoint, it is our feeling that a slow rate of "r." flux per minute has minimized dangerous reactions during the treatment, has decreased the necessity for tracheotomy, has diminished atrophy of the skin and underlying structures, and has avoided late radionecrosis.

We have found that evidence of tumor may persist for several months after the treatment has been completed. Benign tumefactions at the site of the original lesion and edema, often mistaken for malignant residua, may persist for six to eight months after treatment. Because of this we feel that no major procedure, such as surgery or the implantation of radon, should be used after the treatment unless there is definite histological evidence of the presence of disease. Although success has resulted from the use of radon implantations in residua following complete Roentgen treatment, in general our experience with this procedure has been bad. Marked radionecrosis and death have followed its use in some cases. It has been possible in several cases to do a laryngectomy without undue reaction following protracted treatment.

Patients who had recent operative procedures such as laryngofissure or tracheotomy were treated without gross damage or undue reactions in the region of the operated field.

There is still too little experience to definitely draw hard and fast lines for the choice of treatment, i.e., surgery or radiation. In general we have found

that tumors of the tonsil, epiglottis, false cord, pre-epiglottic and small true cord lesions lend themselves to successful Roentgen therapy. In the true cord lesions, which may be removed by laryngofissure, surgery may have its advantages. Poor results with surgery in the hypopharynx lesions show that this group should be relegated to the radiation therapist. Up to the present, lesions which were fixed and infiltrating did not respond to the conventional method of Roentgen therapy. Surgery or greatly protracted Roentgen therapy with periodicity may improve the results. Roentgen films will aid in the establishment of the question of infiltration and the true extent of the lesions, which cannot always be made out by mirror or tube examination.

Finally, it is of the utmost importance to have close co-operation between the laryngologist and the radiation therapist for the establishment of the exact anatomical location of the tumor and to deal with surgical emergencies that may occur.

May I thank Dr. Coutard personally for what he has taught me and my fellow workers.

DR. ROBERT E. BUCKLEY: Over the past few years, as the X-rays have been more and more considered in the treatment of malignancy, and, particularly to us in the field of laryngology, the X-ray treatment for cancer of the larynx, the name of Coutard definitely stands out above all others. During this period he has played the part of the pioneer in a battle which had previously been considered practically hopeless. Like all pioneers he was forced to accept the pitfalls and discouragement, yet to still continue, hoping that eventually happier results would be realized.

Dr. Coutard was probably the first man who attempted to place this non-surgical treatment of cancer on a scientific basis, and likewise to place the clinical observation of his patient in columns of mathematical failures or results. I feel that this Section of the New York Academy of Medicine is highly honored in having him as our guest tonight.

It is interesting to note that the treatment as used by Dr. Coutard, when boiled down to simplicity, consists in an attempt to burn away slowly a tumor mass without at the same time burning away the surrounding normal tissues. In the case of cancer of the larynx this normal tissue therefore would consist of the soft tissues of the neck, and the cartilages of the larynx, with the growth itself inside these cartilages. While, as stated, a necrosis of the laryngeal cartilages has occurred at times, it is difficult to understand why it does not occur in every case, as we well appreciate how susceptible cartilage is to trauma, and how easy it is to produce a chondritis, or a perichondritis. To accomplish by his painstaking efforts a penetration of this cartilage, and also pass these rays in the neighborhood of such important structures as the vagus nerve, jugular vein, etc., was a task which demanded great courage. It is apparent that one of the great problems for future study in deep X-ray therapy, is a comprehensive analysis of the tissue removed at biopsy. While a more or less general idea prevails that the more malignant tumors are more radio-sensitive, and vice versa, the results of this theory are not yet definite enough to be satisfying, and ultimately, let us hope that this biopsy may give an even more definite indication as to what we may expect if radiation is used.

From the surgical standpoint it is a well known fact that there is a certain type of fast growing cancer of the larynx which either starts in an extrinsic position, or so rapidly becomes extrinsic, that surgery is of little avail. Clinically these tumors rapidly assume a sloughing, cauliflower look and, even though metastases cannot be proven, their presence is always suspected on the part of the clinician. X-ray therapy in this type of case, regardless of whether a cure is effected or not, seems to be the only choice and is, I believe, definitely indicated in every case.

There is, of course, the other type of case so frequently seen with small, hard, wart-like, rather inactive epithelioma, usually appearing on the true cord, in which surgery has given, in a large series of cases, results which I believe

absolutely defy competition. Many series of this type of case are on record in the hands of the various clinicians and in general they probably rank as among the best results obtained in true cancer in any part of the body. I do not feel it is justifiable to risk any other treatment than surgery in these cases.

I should like to offer my sincere compliments to Dr. Coutard for his marvelous contribution to the world, and his most scientific and comprehensive paper this evening.

DR. CHARLES J. IMPERATORI: Unfortunately, my contribution is rather in a negative way. My recent experience with cancer has been in the larynx. Surgery cannot promise 100 per cent results and certainly when we have this method of Dr. Coutard's as an alternative in the growths spoken of by Dr. Buckley, we feel we have a sheet anchor. My experience with radiation therapy has been in the region of the tonsil and the larynx. In the tonsil it has been fair. In the larynx, with all due regard for Dr. Coutard and with the greatest respect for his work, my results have been very poor. There are undoubtedly many factors that should be considered regarding my cases and certainly no condemnation is either intended or implied in the method of Dr. Coutard. I am simply stating the results that I have obtained in using radiation therapy in this region. This may be due to improper selection of cases, as regards adenopathy. Another factor that cannot be definitely determined is the degree of infiltration, also possible infection of the growth. Possibly improper X-ray doses, screening, and many other technical details help toward these results. Many of the recent discoveries in science and particularly those in the past few years are such that 50 years ago they were unthought of. The discovery of the electron, radioactivity, and X-rays is within the memory of practically all of us. It is much more recently that artificial radioactivity was discovered at the Curie Institute. The positive electron and then the neutron, and most recently transmutation, have all been discovered within the past few years. All of the above methods or inventions, or discoveries, may eventually be applied to the treatment of cancer and we now feel hopeful that some physical agent mentioned before, even possibly heavy water or the localized induction of fever in the cancerous growth, may be used. Certainly we want a cure, regardless of how it is obtained. It is to such physicist physicians in this field and to such men as Dr. Coutard that we must look. We salute them and pay tribute to them for their efforts.

DR. HENRY B. ORTON: I am honored to have been asked by the Chairman of the Section to participate in the discussion this evening. I can but reiterate Dr. Buckley's remarks as well as those of Dr. Imperatori on the treatment of cancer of the larynx.

Speaking of cancer in the hypopharynx in which Dr. Coutard stated his results were not as brilliant as in the larynx, and the same holds true in our operative results, this, of course, may partially be due to the absence of symptoms until such time as the growth has extended to cause the patient to seek medical aid. At this late stage it becomes necessary to do a block dissection of the neck and then a lateral transthyroid pharyngotomy after the method of Trotter, of London. This operation I have performed a number of times, combining the cold knife with surgical diathermy.

The radiologists will not cure all, neither will the surgeons; but I think if the two would co-operate, using radiation before and then surgery, operating with diathermy, followed by radiation, I believe we could probably obtain better results both from the standpoint of the surgeon as well as the radiologist.

This evening I had hoped that Dr. Coutard would tell us when we should operate and when to radiate in these hypopharyngeal type of tumors, and I trust that this question will be answered by the speaker.

I wish to take this opportunity to thank Dr. Coutard for his interesting presentation.

DR. RAMSAY SPILLMAN: Dr. Francis Carter Wood is known certainly to everybody here, and I take great pleasure in introducing him to speak from the point of view of the pathologist.

DR. FRANCIS CARTER WOOD: I do not propose to follow your Chairman's instructions that I stick altogether to pathology, although the pathologist has the advantage of course in coming in at the end of all things, after the surgeon and others have had their chance, and then has his opportunity to say what was the diagnosis and the cause of death.

In the first place there is a very interesting history to this whole question of the Coutard technique, a history which most men forget. It was by men with no training in medicine that the technique of general biological methods was applied first to animals and then to the two-legged animal we have under our care, but it was only after careful and prolonged study of the biological effects of radiation on the tissues that this method was begun to be applied to man. That is why in Paris 10 years ago they were doing things that we are not yet doing in New York. We hear a lot about the Coutard technique; I know very few people who are using the Coutard technique. We should use it. Yet we hear discussion of an improved or modified or altered Coutard technique in which the radiation is given at a higher rate or with different spacing or something else. The point it seems to me is that before talking about modifying the Coutard technique we should use it. One of the speakers mentioned the fact that it was difficult to put through in a busy clinic. There should not be any clinic too busy to do what is right for the patient. We may have completely to reorganize our clinics so as to handle our patients by the Coutard method, which very few of us are now prepared to do. I visualize a clinic where there will be 25 patients to a ward, all exposed to X-rays at the same time, and yet will not know they are being treated.

Everyone has talked for many years about the fact that radium is so much more effective than X-ray, but you do not hear such talk in Paris. Radium is used in the Institute Curie when an intense local effect is desired and X-ray where a more general radiation is needed. As a matter of fact there is no difference because they both have the same biological effect. They both work through electrons. The primary rays themselves do not do anything but excite electrons. Electrons coming from radium have high speeds, and X-rays a somewhat lower speed, but they kill the cells in the same fashion. Twenty-five years ago a physicist, Dr. William Duane, made that prophecy.

In the earlier type of radiation with more rapid administration, greater damage was inflicted on the normal tissues and few cures were obtained. But it is remarkable that with the Coutard method cures are being obtained in inoperable cases that were previously considered hopeless. What now has to be learned is what Dr. Coutard has discussed, to combine extremely careful clinical observation of the patients with careful application of your radiation in the slow fashion, thereby imitating radium exactly. The ordinary radium pack gives off 2.5 to 10 r. per minute, and the lower rate is the rate given now with X-rays in the Curie Institute in Paris. The advantage of this is that the tissues which are normal and supply blood are less damaged than the abnormal tissues in most instances. Even in four hours of slow exposure there is repair of healthy tissues which obviates as severe an erythema as occurs when the dose is given all at once. It is perfectly certain that cancer cells cannot be killed with a single exposure, unless doses destructive to the healthy tissues are given. That was known in the laboratory 10 to 15 years ago but it has not yet penetrated the practical man's mind. A single dose cannot be given which will kill a resting, mature cell of a squamous cell epithelioma. Why do we use slow doses? To keep healthy tissues healthy and supplying blood to the tumor to keep it growing, and by the divided long exposures you destroy the layer of epidermis, for example, from which the tumor grows and in which the cells are dividing. If you catch the growing cells by prolonged and divided exposures you can then check the growth of the tumor and the body will absorb the rest and destroy it, because most of the cells of the ordinary type of squamous cell epithelioma are dead anyway. That is the biological factor behind the use of this extremely slow and carefully adapted dosage.

Too much radiation has been turning a switch and putting the patient under a tube. Notice that Dr. Coutard calls attention to the fact that you have to

watch the patient and if necessary modify the dosage. The patient's strength must be measured; the old must be treated in a way different from the young; women different from men. There is an enormous amount of clinical knowledge which is necessary to treat a person who has a carcinoma with radiation. Just as much knowledge is required as to do surgical operations, and sometimes more.

It is very delightful to have Dr. Coutard here. I hope he will convey the good wishes of this audience to his colleagues at the Curie Institute when he returns to Paris, to the great Prof. Regaud and Prof. Lacassagne, whom we all know and enjoy. They form one of the most outstanding groups of scientific men working in Europe.

DR. RAMSAY SPILLMAN: Dr. Wood, allow me to express the thanks of the Roentgen Society for your very interesting discussion. I was sure that it would be entertaining and instructive and I was not disappointed.

I take great pleasure in introducing my old professor of pathology, Dr. James Ewing.

DR. JAMES EWING: I recall two periods in the history of Roentgen therapy when that science, if we may call it a science, was in imminent danger of falling into disrepute. One occurred 15 years ago when with the low voltage tube, having succeeded in curing a certain proportion of superficial tumors, ambitious radiologists undertook to deal with the deeper tumors, with generally disastrous results. That method became so widely spread that it was quite clear, in many instances at least, that the total salvage secured by X-ray therapy at that time hardly balanced the damage done. I remember myself feeling that the whole theory of radiation therapy in cancer in those days might be wrong. That danger was relieved by the introduction of the high voltage X-ray tubes with heavier filters and smaller skin dosage. Then we proceeded to repeat the errors, after securing a certain amount of salvage in the deeper tumors, by aiming to clean up the whole field by larger doses, with very disastrous results which many of us remember to our great disappointment. This period, I think, lasted up to about five years ago when Dr. Coutard began in the Curie Institute to consider variations in the dosage, especially prolonging the treatment; the line of thought started then being what we now know as the divided dose technique or Coutard method. This, I feel, rescued deep X-ray therapy from danger of disrepute and started it on a new career which I believe is destined to give greater achievements than in the past.

That is I think the chief historical significance of the Coutard method, for which I congratulate Dr. Coutard. His paper this evening is full of interesting questions and problems, but he made most conspicuous one principle which is worth emphasizing. He finds a rhythm of cellular radiosensitivity which he observes to occur in his cases under different forms of treatment, different periods and different doses. He guides his treatment largely by watching this rhythm. This is a comparatively new conception. He has done a great service by clarifying the problem. What is there in this idea of the rhythm of cellular radiosensitivity? Today attention is riveted entirely upon the reaction of the tumor cells, and no doubt the main factors reside in the behavior of neoplastic epithelium. We hear that adult cells are more resistant and undifferentiated cells are less resistant and behave differently. I have no doubt that the main factors reside in the neoplastic cells, but the further my experience goes with observation of these cases, and in this instance it is backed very largely by histological studies of radiated tissues, I am more than ever convinced that the problem is more complex than just a cellular problem and that the tissues react as organs. We must not neglect the bed of the tumor by paying exclusive attention to the tumor cells. We have blood vessels, nerves, lymphatics, connective tissue and other structures as well as epithelium, and in my observation the cure of the cancer depends largely upon the reaction between the degenerating epithelial cells of the tumor and the reactive processes in the bed of the tumor. I feel that the idea of killing cancer cells has been overdone and that we must abandon the idea that the main object of radiation therapy is to kill

the cancer cells outright. Instead of that Coutard now goes to work with repeated small doses, injuring the cells and causing a cell degeneration, and at the same time a reactive process which is curative mechanically and has many other effects on the remaining tumor cells which are not dead. We must regard this process largely as a result of a reactive process in the inflamed bed of the tumor. It is most remarkable in watching the course of an epidermoid carcinoma of the lip under radiation to see an infection receding, new epithelium growing from the edge and cancer cells still degenerating, all in the same field. It is almost inconceivable. Still it happens.

DR. HENRI COUTARD: I want to thank the president of the section of Oto-Laryngology of the New York Academy of Medicine and the president of the New York Roentgen Ray Society for their invitation to address their respective societies on this subject. I also greatly appreciate the remarks made by the discussors.

In answer to Dr. Orton's question whether surgery or irradiation is preferable for epitheliomas of the hypopharynx, I might say that, although the results of X-ray therapy in these epitheliomas are not good, they are better than surgery. The majority of hypopharyngeal epitheliomas are undifferentiated and operative interference is apt to be followed by dissemination of the growth.

In epitheliomas arising from the posterior surface of the cricoid the results of X-ray therapy have, in general, been very poor. Reaction of the posterior portions of the cricoid and arytenoids, followed by X-ray therapy, might be preferable if the tumor is well differentiated.

AMERICAN LARYNGOLOGICAL ASSOCIATION.

The fifty-eighth annual meeting of the American Laryngological Association will be held at the Book-Cadillac Hotel, Detroit, Mich., Monday, Tuesday and Wednesday, May 25, 26 and 27. The first session will begin at 10 A. M. on Monday, May 25.

The Council recommended for election to Emeritus Fellowship, Dr. Joseph L. Goodale, of Boston; for election to Honorary Fellowship, Dr. Herbert Tilley, of London, England; for election to Corresponding Fellowship, Dr. John G. Fraser, of Edinburgh, Scotland; and for reinstatement to Active Fellowship, Dr. John L. Barnhill, of Florida.

The American Bronchoscopic Society meeting will be held on May 27, and will be followed by the meeting of the American Otological Society on May 28 and 29. All of these meetings will be held at the Book-Cadillac Hotel.

NASHVILLE ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY.

Meeting of Dec. 19, 1935.

Aberrant Thyroid Gland. Dr. Guy Maness.

J. P. G., a white male, age 40 years, was first seen on June 14, 1928, regarding a tumor on his tongue. He had noted a small enlargement at the root of the tongue three years previously. The tumor had gradually increased in size until when first seen it was about the size of a large hickory nut. The only symptom complained of was an uncomfortable feeling of a mass on his tongue and some difficulty in swallowing. One doctor had previously incised the mass three or four times and another doctor had used radium and fulguration on the mass. This did not destroy the tumor or make much difference in its size.

The patient's past history and family was irrelevant. The physical examination was negative, except for the presence of a mass at the base of the tongue. The tumor was about the size of a large hickory nut, rather firm in consistency, smooth, and the well was partially covered with small dilated veins. The mass did not pulsate.

There was no enlargement of the glands of the neck and no evidence of a thyroglossal duct. The thyroid was not enlarged. The nose and throat examination was negative except for the tumor mass on the tongue. The pulse, blood pressure, temperature, and laboratory work were normal.

It was decided best to remove the tumor. On June 15, 1928, the patient was given an ether anesthetic and the tumor mass, situated at the root of the tongue and slightly to the right of the mid-line, was brought into view. An unsuccessful attempt was made to aspirate the mass. An incision was made around the tumor and the mass was removed by blunt dissection. There was apparently a duct leading from the lower part of the mass toward the hyoid bone. This was dissected out until an apparent end was reached. The wound was closed with catgut sutures. The tumor was covered with a capsule. Cross-section of the mass gave the appearance of thyroid tissue. The patient's recovery was uneventful and he has had no recurrence of the tumor since its removal, which was over seven years ago.

Microsection showed typical thyroid tissue with characteristic picture of adenoma with evidence of thyroglossal duct. The tumor mass was evidently an aberrant thyroid gland.

MINNESOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY.

SECTION OF OTO-LARYNGOLOGY.

Meeting of Oct. 11, 1935.

Dr. Lawrence R. Boies read his inaugural thesis, entitled "Abducens Paralysis: A Study of Four Cases Complicating Acute Mastoiditis and One Case Complicating an Acute Sphenoiditis." Lantern slides were shown.

Case 1 was that of a boy, age 8 years, in which the pyramid was drained at a secondary operation through a group of cells leading into the pyramid above the jugular bulb. The abducens paralysis cleared in four weeks; complete recovery was otherwise uneventful.

Case 2 was a girl, age 7 years, in which the symptoms of "petrositis" developed after a mastoidectomy. A second operation was done without uncovering any significant pathology and the lateral sinus and middle fossa dura above the tegmen of the mastoid were widely exposed. An abducens paralysis occurred after this second operation, but otherwise there was general improvement in the patient's symptoms so that no further surgical procedures were carried out. The abducens paralysis cleared in one month.

Case 3 was a boy, age 18 years, with extremely large mastoids, who developed his symptoms of "petrositis" after a simple mastoidectomy. His pyramid was drained by uncapping the roof in the posterosuperior angle; the pyramid was explored to the level of the superior prominence denoting the internal auditory meatus. The abducens paralysis had cleared on the twenty-sixth day after the operation and convalescence was otherwise uneventful.

Case 4 was a girl, age 11 years, with extremely large mastoids, who was very toxic from the onset of her middle ear suppuration. The culture from the middle ear was reported to be a pneumococcus (type not determined). Simple mastoidectomy was performed on the tenth day of her illness with immediate symptomatic improvement, but a week later the mastoid was again explored because of fever and continued suppuration. At this operation the lateral sinus and the middle fossa dura above the tegmen of the mastoid were widely uncovered. Again improvement followed, but, at the end of another week, the fever again became elevated, suppuration had continued, the child complained of headache, temporoparietal in location on the involved side, and an abducens paralysis developed. A third operation was done and the petrous pyramid opened for a short distance behind the posterior margin of the labyrinth along the posterosuperior margin of the pyramid. Convalescence followed and the paralysis had cleared in one month.

Case 5. A fifth case of abducens paralysis was reported which occurred in a woman, age 28 years, on about the third day of an upper respiratory infection, characterized by a nonpurulent rhinitis, malaise, frontal headache, and a moderate fever. Sinus X-ray studies showed a generalized cloudiness of a mild degree. Displacement irrigation after the method of Proetz was carried out and in two days distinct improvement in the abducens paralysis was noted; it cleared completely in one week.

The left sphenoid sinus was suspected as the probable contact for inflammation to the left abducens nerve at the site where this nerve passes through the abducens canal (Dorello's canal) to enter the cavernous sinus. The sphenoid sinuses were studied by introducing lipiodal. The left sinus was very small; the right sinus was very large and extended around the posterior aspect of the right one to apparently reach the lateral limit of the base of the sphenoid sinus area on the left side. The findings, therefore, point to the probability that inflammation involving the right sphenoid sinus caused a left abducens paralysis.

